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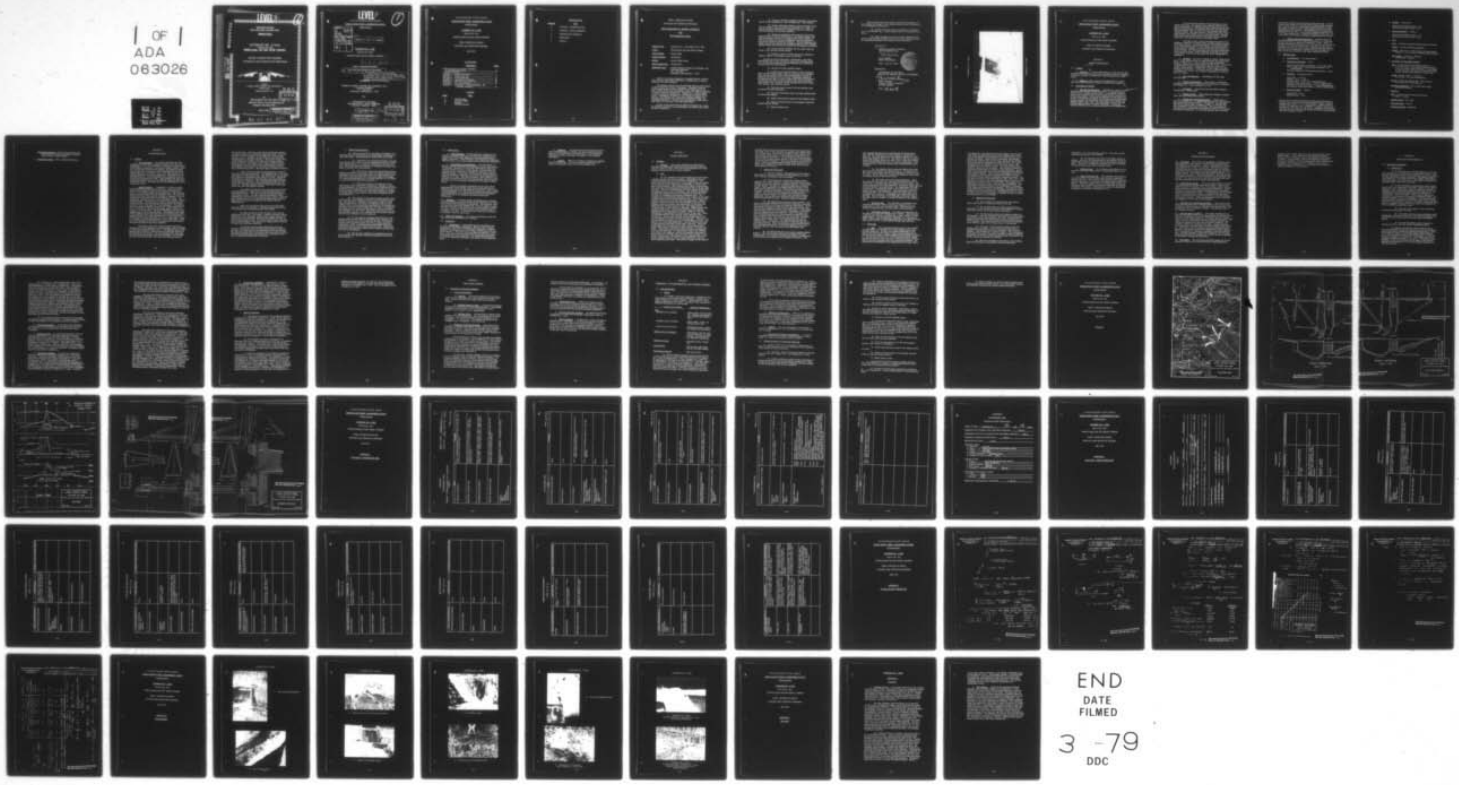

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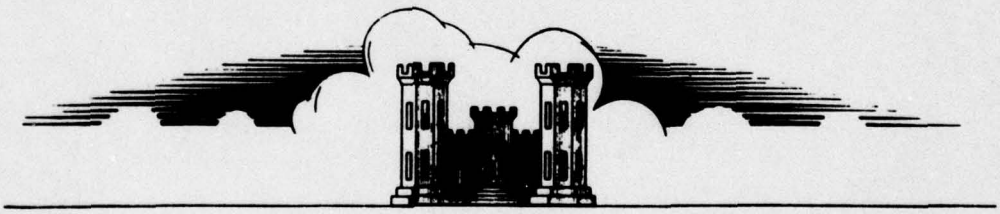
LEVEL II

SUSQUEHANNA RIVER BASIN
GRASSY ISLAND CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

OLYPHANT NO. 2 DAM
NDS ID NO. 382
PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
Harrisburg, Pennsylvania 17105

For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

MAY 1978

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LEVEL II

(1)

SUSQUEHANNA RIVER BASIN

GRASSY ISLAND CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

(15) DACW31-78-C-0046

OLYPHANT NO. 2 DAM

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PENNSYLVANIA GAS AND WATER COMPANY

(10) A. C. Hooke pa-3

PHASE I INSPECTION REPORT

(6) NATIONAL DAM INSPECTION PROGRAM.
Pennsylvania Gas and Water Company.
Olyphant Number 2 Dam (NDS ID Number 382).
Susquehanna River Basin, Grassy Island Creek,
Lackawanna County, Pennsylvania.
Phase I Inspection Report.

Prepared by

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
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P.O. Box 1963
Harrisburg, Pennsylvania 17105

For

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

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SUSQUEHANNA RIVER BASIN

GRASSY ISLAND CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

OLYPHANT NO. 2 DAM

NDS ID No. 382

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

MAY 1978

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C	Hydrology and Hydraulics.
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PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Olyphant No. 2 Dam (NDS ID No. 382)
Owner:	Pennsylvania Gas and Water Company
State Located:	Pennsylvania
County Located:	Lackawanna
Stream:	Grassy Island Creek
Date of Inspection:	26 April 1978
Inspection Team:	Gannett Fleming Corddry and Carpenter, Inc. Consulting Engineers P.O. Box 1963 Harrisburg, Pennsylvania 17105

Based on the visual inspection, available records, calculations and past operational performance, Olyphant No. 2 Dam is judged to be in fair condition.

The spillway will not pass the Probable Maximum Flood (PMF) or one-half the PMF without overtopping. Therefore, based on criteria established for these studies by the Department of the Army, Office of the Chief of Engineers (OCE), the spillway capacity is rated as seriously inadequate. Olyphant No. 3 Dam is about 0.3 mile upstream of Olyphant No. 2 Reservoir on Grassy Island Creek. Considering the effects of the combined Olyphant No. 2 Reservoir and Olyphant No. 3 Reservoir surcharge storage, the existing Olyphant No. 2 spillway can accommodate a flood with a peak inflow of 16 percent of the PMF peak inflow.

In view of the concern for the safety of Olyphant No. 2 Dam, the following measures are recommended to be taken by the Owner as soon as practical:

(1) Develop a detailed emergency operation and warning system for the Olyphant No. 2 and Olyphant No. 3 Dam system.

(2) Perform additional studies to more accurately ascertain the spillway capacity required for Olyphant No. 2 Dam, as well as the nature and extent of mitigation measures required to make the spillway hydraulically adequate.

(3) Perform investigations and studies to more accurately ascertain structural deficiencies in the spillway apron, left spillway training wall and the sloughed area of the earthfill, as well as the nature and extent of mitigation measures required to make these features structurally adequate. The investigations and studies should also address the structural adequacy of the masonry gravity section and downstream earthfill for all operating conditions.

(4) Provide closure facilities for the outlet works upstream of the masonry gravity section.

(5) Provide a means of access across the spillway or spillway channel and adequate access to the dam.

In order to correct operational, maintenance, and repair deficiencies and to more accurately assess the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner:

(1) Remove brush from earthfill slopes.

(2) Provide six observation wells or other instrumentation in the earthfill slopes, three on each side of the spillway. Also, one observation well or other instrumentation should be placed in the vicinity of the wet area. Instruments should be read periodically and any rises in water level should be analyzed to determine the effect on the stability of the earth slopes and earth masonry dam. Monitor wet and seepage areas and if conditions worsen, take necessary action.

(3) Place fill under the end of the left spillway wall and provide erosion protection.

(4) Raise the downstream end of the right spillway wall to prevent overtopping.

(5) Repair deteriorating concrete on the spillway walls.

(6) Repair or replace mortar in the spillway walls and masonry gravity section.

(7) Repair leaking valve.

Until remedial work that corrects hydraulic deficiencies of the spillway is complete, the following measures are recommended to be undertaken by the Owner:

(1) Provide round-the-clock surveillance of Olyphant No. 2 and Olyphant No. 3 Dams during periods of unusually heavy rains.

(2) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

A. C. HOOKE
Head, Dam Section

Date: June 16, 1978

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
ALBERT CHARLES HOOKE
ENGINEER
No. 2201-E

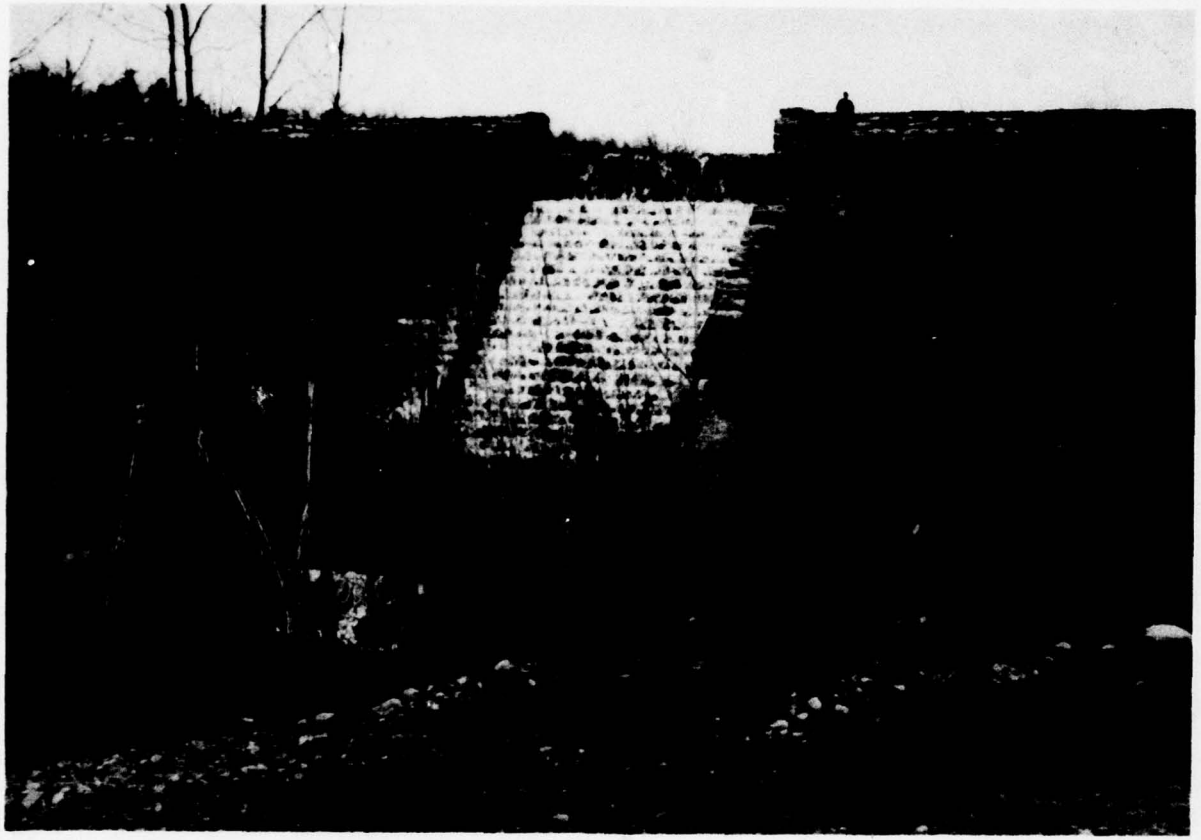
Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

Date: 29 Jun 78

OLYPHANT NO. 2 DAM



Olyphant No. 2 Dam

SUSQUEHANNA RIVER BASIN

GRASSY ISLAND CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

OLYPHANT NO. 2 DAM

NDS ID No. 382

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

SECTION 1

PROJECT INFORMATION

ABSTRACT

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

ABSTRACT

a. Dam and Appurtenances. Olyphant No. 2 Dam is a composite earthfill-masonry gravity structure. The masonry gravity structure has a stepped upstream face. The earthfill is placed against the downstream face of the masonry gravity structure and has irregular slopes. The top of the earthfill is 3 feet below top of dam. Earthfill placed against the upstream face of the masonry gravity structure has an irregular slope with top of earthfill considerably below top of dam. The total length of dam is 340 feet and the height of dam is 74 feet at streambed. A small dry masonry retaining wall is provided along part of the earthfill toe.

A 30.5-foot long masonry gravity spillway is in the middle of the dam. The spillway has a vertical upstream face with no fill against it. Spillway discharge passes over the stepped downstream face of the spillway and onto a concrete apron. Spillway training walls on each side of the spillway and apron contain the flow. The apron ends at a natural rock ledge. The right training wall extends part way along this ledge. Spillway discharge passes around the end of the right training wall and drops over a natural rock ledge to the stream below.

The outlet works, which is located to the right of the spillway, consists of an intake tunnel, masonry intake structure with screen chamber, and discharge pipe. The discharge pipe is an 18-inch diameter pipe that runs through the masonry gravity section and the earthfill to a valve house at the downstream toe of the earthfill. The pipe discharges into the stream immediately below the valve house. Various features of the dam are shown on the Plates at the end of the report and on the Photographs in Appendix D.

b. Location. The dam is located on Grassy Island Creek about 2 miles upstream from its confluence with the Lackawanna River. Olyphant No. 2 Dam is shown on USGS Quadrangle, Olyphant, Pennsylvania, with coordinates N41°27'55" - E75°32'05" in Lackawanna County, Pennsylvania, and is 2 miles east of Winton, Pennsylvania. Olyphant No. 2 Dam is about 0.2 mile upstream of Olyphant No. 1 Dam and about 0.3 mile downstream of Olyphant No. 3 Dam. The location of Olyphant No. 2 Dam is shown on Plate 1.

c. Size Classification. Intermediate (74 feet high, 220 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for Olyphant No. 2 Dam (Paragraph 5.1.e.).

e. Ownership. Pennsylvania Gas and Water Company, Wilkes-Barre, Pennsylvania.

f. Purpose of Dam. Water supply for Olyphant, Pennsylvania, and surrounding communities.

g. Design and Construction History. Olyphant No. 2 Dam was designed by J. H. Rittenhouse of Scranton, Pennsylvania, and constructed by Burke Brothers, Contractors. The dam was built for the Winton Water Company in 1888. In 1903 the dam was overtopped during a local rainstorm. The only damage resulting from this overtopping was apparently erosion of part of the downstream embankment. A 3-foot high parapet wall was added

on top of the masonry gravity section in the same year. In 1914, the dam was studied by the Pennsylvania Water Supply Commission. In this study the Commission recommended that the spillway walls be raised to prevent embankment erosion from water splashing from the spillway. This modification was constructed between 1919 and 1924. It consisted of placing masonry on top of the then existing wall. During the floodflow of May 1942, the water level in the reservoir reached the approximate top of dam.

h. Normal Operational Procedure. Water in excess of normal streamflow can be brought into Olyphant No. 2 Reservoir by releases from the upstream Olyphant No. 3 Dam. Water, to increase streamflow downstream, is drawn from the outlet works at the dam by an 18-inch diameter line. This line is also used to drawdown the reservoir and to remove sediment from the reservoir. The water in the downstream channel flows into Olyphant No. 1 Dam, which has an intake for the water distribution system.

1.3 Pertinent Data.

a. Drainage Area. 2.9 square miles.*

b. Discharge at Damsite. (cfs.)

Maximum known flood at damsite - 1,117 (May 1942).
Water supply line at maximum pool elevation - 60 (approximate).
Spillway capacity at maximum pool elevation - 1,140.

c. Elevation. (Feet above msl.)

Top of dam - 1,349.0.
Spillway crest - 1,343.9.
Spillway apron - 1,297.3 (at downstream toe).
Streambed near outlet works - 1,275.0 (approximate).
Upstream invert intake tunnel - 1,285.9 (approximate).
Downstream invert outlet works - 1,280.0 (approximate).

d. Reservoir Length. (Miles.)

Normal pool - 0.20.
Maximum pool - 0.21.

* Records of the Owner and Division of Dams and Encroachments, Pennsylvania Department of Environmental Resources, show the drainage area to be 2.3 to 2.4 square miles. Gannett Fleming Corddry and Carpenter, Inc., computed 2.9 square miles for the drainage area and used it in this study. Apparently, the drainage area was never re-checked after the latest USGS Quadrangle Sheet was made available in 1946.

e. Storage. (Acre-feet.)

Normal pool (spillway crest) - 177.
Maximum pool (top of dam) - 220.

f. Reservoir Surface. (Acres.)

Normal pool (spillway crest) - 8.2.
Maximum pool (top of dam) - 8.8.

g. Dam.

Type - Composite earthfill-masonry gravity structure.

Length - 340 feet (including spillway).

Height - Main dam - 74 feet (above existing stream).
Spillway - 47 feet (above spillway outlet channel).

Side Slopes - Upstream - unknown.
Downstream - variable.

h. Diversion and Regulating Tunnels.

Type - Intake tunnel with hydraulic opening of 26.3 square feet. Wet masonry intake structure, 6-feet by 4-feet inside dimensions. Outlet pipe, 18-inch diameter cast-iron, runs through masonry gravity structure and earthfill to valve house.

Length - Intake tunnel - 71.25 feet.
Outlet pipe - 115 feet (approximate).

Access - Intake structure is wet. Valve house is accessible from downstream toe.

Regulating Facilities - Two 18-inch gate valves connected in series.

i. Spillway.

Type - Masonry gravity broad-crested weir (width 7.5 feet).

Length of Weir - 30.5 feet.

Crest Elevation - 1343.9.

Upstream Channel - Reservoir.

Downstream Channel - 65-foot long concrete apron and natural rock ledge which drops vertically about 22 feet to natural stream.

j. Regulating Outlets - None, except outlet works.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. Very little engineering data was available for review for the original structures or for the 1903 modifications. In a study performed in 1914 by the Pennsylvania Water Supply Commission, an account of design concepts, geology, construction materials and methods, and design features was prepared for the structures from interviews with the Owner, visual inspection, and other sources. The 1914 study also included analyses for hydrology, hydraulics, and stability of the principal features. Load assumptions and a summary of the results of the analyses are on file. That study was the basis for recommended improvements to the spillway walls that were made in the early 1920's. No design data for this modification was available for review.

b. Design Features. Olyphant No. 2 Dam is a composite earthfill-masonry gravity structure. A plan and profile of the dam is shown on Plate 1A and sections are shown on Plate 2. The earthfill against the upstream face of the masonry gravity structure starts far below the top of dam. The exact elevation of the top of the upstream earthfill is unknown, as is the composition of the material and the steepness of slope. The downstream earthfill consists of clay and broken stones, and has variable slopes. The earthfill to the left of the spillway starts 3 feet below the top of the masonry gravity section and slopes down on a 1V on 1.4H slope for 17 feet vertically. The embankment then slopes irregularly downward for 3 feet vertically on a 1V on 4.33H slope. The slope then drops another 7 feet vertically on a 1V on 2H slope. The entire earthfill to the left of the spillway warps into the left abutment. The earthfill to the right of the spillway starts 3 feet below the top of the masonry gravity section and drops 22.5 feet vertically on a 1V on 2.2H slope. It then drops 22.3 feet vertically on a 1V on 1.05H slope. Finally, it drops 11.9 feet vertically on a 1V on 1.93H slope. At the toe of the earthfill on the right of the spillway is a dry masonry retaining wall with the top 5 feet exposed.

The upper 3 feet of the gravity masonry section is a parapet wall and is trapezoidal in cross section, with a top width of 2 feet and a bottom width of 3 feet. The upstream face of this parapet wall is vertical. Below this wall is the main section of the masonry gravity section. The main section has a top width of 6 feet and is symmetrical about its centerline. For the upper 40 feet of the main section, each face has a 12-inch step for

each 5-foot drop. Forty feet below the top of the main section, the steps increase to 18 inches for each 5-foot drop. The overall ratio of width to height, 70 feet below the top of the main section, is 0.5. The entire gravity section is constructed of conglomerate and sandstone masonry. The gravity section abuts a near-vertical rock ledge on the right and a natural earthen slope on the left. The length of the section is about 340 feet. The rightmost 200 feet of the section is founded on sandstone. The remainder of the section is founded on a mixture of clay, sand, gravel and boulders. Masonry details are shown on Plate 3.

A 30.5-foot long spillway (Photograph D) is about in the center of the gravity section. The spillway crest is 5.15 feet below the top of the parapet wall. The upstream face of the spillway section is vertical; the crest width is 7.2 feet. The downstream face is vertical for 5 feet and then steps downstream on an overall 1V on 1H slope. The overall ratio of width to height of the spillway section, at a level 45 feet below the crest, is about 1.0. Masonry spillway training walls extend along each side of the crest and stepped cascade.

The spillway discharge onto a concrete apron 65 feet long (Photograph C). Masonry and concrete training walls extend along the apron. The apron and left training wall end at a natural rock surface. The right training wall extends further downstream to channel the flow along the rock surface. After the right training wall ends, the spillway discharge turns right and drops over the natural rock ledge into the natural channel (Photograph C).

There is a dry masonry wall at the toe of the earthfill to the right of the spillway. This wall is exposed for about 5 feet and acts as a retaining wall for the earthfill.

An intake tunnel and intake structure are on the upstream side of the dam. The tunnel, a masonry structure with an arched roof, has a waterway opening of 26.3 square feet and it extends 71 feet to the intake structure immediately upstream of the masonry gravity section. The intake structure has a wet well with a screen chamber. The structure is located about 45 feet to the right of the spillway centerline.

An 18-inch cast-iron pipe extends from the intake structure, through the gravity masonry and earthfill sections of the dam, to a valve house at the downstream toe of the earthfill. The valve house has two 18-inch gate valves connected in series. The 18-inch diameter pipe extends from the valve house to the point of discharge immediately downstream.

c. Design Considerations.

(1) Some observations on the design of Olyphant No. 2 Dam were noted by the Pennsylvania Water Supply Commission in their 1914 report. The following are excerpts from that report:

(a) "According to the proposed drawings, the original intention was to add an earthen embankment along the inside of the wall of about 2 to 1 slope and extending to the top of the dam. No definite answer or reasons for changing the design were given by the men who I interviewed."

(b) "The masonry wall of the nonoverflow section, perhaps best termed a face wall, because in reality it retains the embankment along the downstream side, is a very different structure and, as seen from the ratio of its base width to the height, it is correctly proportioned as a retaining wall but it is not stable as a gravity wall for hydrostatic pressure."

(c) "The worst feature of the structure is the steep slopes of the downstream embankment, because an excessive precipitation, as occurred in 1903 on this watershed and also in 1914 on the Roaring Brook watershed which adjoins it, would erode the slope and the masonry wall would certainly be stressed to its limit because the reservoir under these conditions would undoubtedly fill . . ."

(2) The stability of the masonry gravity section seems to rely totally on the support provided by the downstream earthfill. This downstream earthfill is irregularly sloped and quite steep in some areas. The level of the phreatic surface in the earthfill and the passive pressures developed by the earthfill are unknown. They are of prime importance, however, in evaluating the stability of the masonry gravity section, which was apparently designed as a core wall. Should the dam experience a sudden drawdown condition, it is uncertain that the masonry gravity section could withstand the loads imposed.

(3) The dry masonry retaining wall at the toe of the earthfill section to the right of the spillway was reportedly constructed to protect the toe from tailwater erosion. If the earthfill were placed directly against this wall, a piping potential would exist. There is no information available for review that indicates if there is a filter layer behind this wall. Neither are any records available that indicate that toe drains were provided at the toe of the earthfill.

(4) This dam was apparently not designed in accordance with the best standard engineering practice known at the time of design.

2.2 Construction.

a. Data Available. Construction data available for review for the original structures was limited to information contained in the 1914 report prepared by the Pennsylvania Water Supply Commission. That information was obtained by interviews with the Owner, and it gives details of the construction operations.

b. Construction Considerations. The 1914 report, in general, praises the quality of construction used in the structure. For example, information is cited that indicates the stone was carefully selected and was of high quality, and excavation for foundations was carried to such depths as necessary to ensure adequate support. In general, the accounts of construction are such that it appears reasonable care was used in construction of Olyphant No. 2 Dam. The same Contractor, Burke Brothers, apparently constructed virtually all of the masonry dams in the area and was one of the major dam contractors in the eastern United States.

Review of available information for the early 1920's improvements to the spillway walls did not yield pertinent information with respect to the character of that work. From review of the photographs in the files of the Pennsylvania Office of Dams and Encroachments, it is estimated that the 1V on 2H earthfill slope to the left of the spillway was placed during this modification.

2.3 Operation. No formal records of operation were reviewed. Based on information from the Owner and the caretaker of the dam, all structures have performed satisfactorily. The caretaker, who has been associated with Olyphant No. 2 Dam for about 15 years, said that he could not recall when flow over the spillway exceeded 1 foot. Records of the Owner show that the flood of record occurred in May 1942. During this flood, water was 5 feet over the spillway, about at top of dam.

2.4 Other Investigations. No known investigations other than those previously described were reviewed.

2.5 Evaluation.

a. Availability. Engineering data was provided by the Division of Dams and Encroachments, Bureau of Water Quality Management, Department of Environmental Resources, Commonwealth of Pennsylvania and by the Owner, Pennsylvania Gas and Water Company. The Owner made available an engineer, a caretaker, and a valve crew for information and operating demonstrations during the visual inspection. The Owner also researched his files for additional information upon request of the inspection team.

b. Adequacy. The type and amount of design data and other engineering data is limited, and the assessment must be based on the combination of available data, visual inspection, performance history, hydrologic assumptions, and hydraulic assumptions.

c. Validity. There is no reason to question the validity of the available data. The typical sections supplied by the Owner are apparently meant for concept purposes only.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The general appearance of this project indicated that some project features have deteriorated with age and are in need of repair, while other project features have been properly maintained and are in good condition.

b. Dam.

(1) The earthfill on the downstream side of the masonry gravity section was in fair condition. The entire slope was covered with tall brush and small trees (Photograph A). The Owner reported that brush was cut 2 years ago. There was sloughing on one area of the embankment (Photograph H), where there was no brush growing. This sloughed area, about 35 square feet, was at the top of the embankment immediately left of the left spillway wall. The soil in the sloughed area was slightly damper than the adjacent soil; it was not saturated. The earthfill immediately below the sloughed area was too irregular to ascertain if the soil from the sloughed area had been deposited there. The sloughed area is immediately adjacent to the junction of the masonry gravity structure and the left spillway wall. The mortar in the masonry joints at this junction was very deteriorated. Approximately one-half of the way down the earthfill to the left of the spillway, where the slope of the embankment is relatively flat, there were two distinct mounds of soil, each approximately 10 feet long by 6.5 feet wide by 1 foot high. These mounds were overgrown with brush. The earthfill behind the left spillway training wall had settled about 6 inches. There is a wet area (Photograph F) approximately 50 feet long by 16 feet wide, about 100 feet downstream of the spillway crest centerline offset 30 feet left. This wet area is about 50 feet downstream of the toe of earthfill to the left of the left training wall. When the inspector walked over this area, his boot sank about 3 inches. The area is in a 2-inch deep depression. The left training wall ends 20 feet upstream and about 12 feet right of the area. Below the downstream end of the left training wall, in the natural earth slope, clear water is seeping at a rate of about 0.25 gallon per minute. Many other areas of the slope are mossy and appear to have recently been wet. No defects were noted in the earthfill to the right of the spillway, except the extensive brush growth. The dry masonry retaining wall at the toe of this earthfill is overgrown in many areas. The earthfill on the upstream side of the masonry gravity structure was not observable as the reservoir was at spillway crest level. The mortar in almost all the exposed

masonry joints of the masonry gravity structure was deteriorated. The upper 3 feet of this structure is a parapet wall without earthfill on either side. The mortar in the joints of this parapet wall was severely deteriorated. A rule could be inserted up to 4 inches in some of these joints. At the junction of the left training wall and the masonry gravity structure, the mortar was deteriorated as was noted previously. Grass was growing in some of these joints. There was slight seepage through these masonry joints. There was insufficient seepage to collect at the toe of the exposed portion of the wall.

c. Appurtenant Structures.

(1) The main spillway (Photograph D) had no observable defects. Water was flowing over the spillway and, therefore, a detailed inspection was not possible.

(2) The concrete apron below the spillway (Photograph C) was in poor condition. Much of the concrete had deteriorated to the point where the foundation material, a coarse gravel, was visible. The apron is unevenly bulged over its entire length. There appeared to be seepage from the junction of the apron and the left training wall. Since water was flowing over the apron, a definite conclusion as to the seepage could not be reached. The concrete at the downstream end of the apron, where it meets the natural rock ledge, was completely eroded. Apparently, this junction was originally constructed of rubble blocks covered with concrete. Only the rubble is remaining.

(3) The right training wall was in fair condition. The wall is constructed partially of concrete and partially of masonry. Some of the mortar in the masonry joints has deteriorated. At the area where the masonry section joins the concrete section, the concrete was spalling for about 1-inch depth over a 5-foot length. The concrete in this area had evidence of leaching, as white deposits or efflorescence was observed. Each of the three concrete monoliths downstream of this area had a horizontal crack about 1 foot from the top of wall and 1/16-inch wide, extending over its entire length. The last monolith of this wall was of rubble masonry construction. This monolith extends past the spillway apron. The mortar in the joints of this monolith was in very poor condition. There was evidence of this monolith having been overtopped previously, as the brush behind the wall was bent away from the wall, and stones and other debris were evident.

(4) The left training wall was in poor condition (Photograph E). The construction of the wall is similar to the right training wall. The concrete monolith at the junction of the masonry and concrete was spalling over 20 percent of its face. The

next monolith downstream was spalling over 20 percent of its top. The left training wall masonry section is bowed (Photograph G). The wall leans toward the spillway channel on a batter of approximately 80V on 1H. The center of the wall is bowed toward the spillway channel by about 1 foot. There was settling of the earthfill behind this wall, as was noted previously. The downstream end of the left training wall is undermined by about 6 inches.

(5) The spillway channel atop the natural rock ledge has a few small branches scattered across it. The left bank of the channel was shaped such that the suspicion of previous sliding arose. As the slope was covered with relatively mature trees, any sliding would not have been recent.

(6) The outlet works was in good condition. Since the intake structure was wet, with water in the structure at reservoir level, a detailed structural inspection was not made. The valves appeared to be in good condition. The Owner stated that they had been rebuilt 2 years previously. The downstream valve had a slight leak. The upstream valve in the outlet works was fully open on the day of the inspection. The downstream valve was 10 percent open. Two men easily opened the downstream valve 50 percent in 15 minutes. No seepage was evident adjacent to the pipe. The only access to the right side of the dam, where the outlet works is located, is across the bottom of the spillway apron.

d. Reservoir Area. The watershed is completely undeveloped and wooded. Earthen slopes are generally mild, although there is much rock outcrop visible. Pennsylvania Gas and Water Company owns and posts most of the watershed.

e. Downstream Channel. The channel immediately below the dam is steep and streamgrade is bedrock. Approximately 1,000 feet downstream is Olyphant No. 1 Dam, which is a water supply intake. The channel below Olyphant No. 1 Dam runs at least 1 mile through an abandoned strip mine. The unpaved access road to Olyphant No. 2 Dam extends through this strip mine.

3.2 Evaluation.

a. Dam. The continued growth of brush on the earthfill is undesirable. The sloughed area could indicate serious embankment problems. A review of available photographs in the files of the Pennsylvania Office of Dams and Encroachments indicates that this area of earthfill apparently had problems previously. The recommendation of the 1914 Pennsylvania Water Supply Commission report on this dam was to raise the spillway training walls to prevent splashing water from eroding the earthfill. Although this recommendation was implemented in the early 1920's,

an inspection by the Pennsylvania Water Supply Commission in 1945 noted that splashing water from the spillway had eroded some of the earthfill at approximately the same location as the present sloughing. There is also a possibility that seepage through the masonry joints in this area, during periods of high pool, could collect sufficiently to erode the area. It is also a possibility that the earthfill in this area is not stable. The sloughed area is of general concern. No special significance could be attached to the two lumps. They could be remnants of construction operations or evidence of past instability. As the lumps are covered with brush, they are apparently not indicators of an active condition. The wet area and seepage at the toe of the earthfill to the left of the spillway were noted on various Pennsylvania Water Supply Commission inspection reports. The wet area was noted in the inspections of 1928, 1933, 1941, 1945 and 1953. It was not noted in inspections before 1928 nor in the inspections of 1930, 1934, 1957 and 1965. The seepage was noted only in the 1933, 1941, 1945 and 1953 inspections. The descriptions in these inspections are insufficient to determine if the areas under discussion are identical. The area has apparently stabilized but, because of the potential seriousness of the problem, it is of general concern. Deteriorated mortar in masonry joints increases the possibility of seepage and does not allow the structure to act as a monolith.

b. Appurtenant Structures.

(1) No conditions were observed on the spillway which might present a significant hazard to the dam.

(2) The concrete apron was almost completely deteriorated. It may not protect the toe of the spillway or training walls from erosion during high spillway discharges.

(3) The right training wall was showing evidence of deterioration. Lack of maintenance may increase the deterioration and thereby threaten the stability of the wall. Continued overtopping of the wall at the downstream end could threaten the toe of the earthfill. The horizontal cracks in the concrete monoliths are of unknown origin and of slight concern at the present.

(4) The cause of the bowing and tilting of the left training wall is unknown. Failure of this wall would have a significant detrimental effect on the earthfill to the left of the spillway. The condition is of general concern. The undermining at the downstream end of the wall is probably caused by spillway discharges. Continued undermining of this wall could lead to its failure, which may threaten the earthfill.

(5) Since any sloughing in the slopes of the spillway channel downstream of the spillway apron has apparently

stabilized, it is not of immediate concern. This area is some distance from the toe of the earthfill.

(6) The leakage at the valve is of slight concern at present. Access to the earthfill right of the spillway and to the outlet works would be impossible during all but minor spillway flows. Therefore, no drawdown facilities are able to be operated until the pool level reaches spillway crest.

c. Reservoir Area. No conditions were observed in the reservoir area which might present a significant hazard to the dam.

d. Downstream Channel. No conditions were observed in the downstream channel which might present a significant hazard to the dam. It is uncertain that quick access to the dam could be gained over the access road during severe weather conditions. The Owner reported that the caretaker had to walk up the road at periods during the previous winter when the weather conditions were severe. Additional discussion on downstream conditions is presented in Paragraph 5.1.e..

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at spillway crest Elevation 1343.9 with excess reservoir inflow cascading over the stepped masonry spillway. Inflow is augmented by releases from Olyphant No. 3 Dam, if necessary. An 18-inch diameter cast-iron pipe water supply line draws water from the reservoir at Elevation 1285.9 and water is released directly into the downstream channel. This stream flows into Olyphant Dam No. 1, an intake reservoir about 1,000 feet downstream. Two gate valves, connected in series, are at the downstream end of the water supply line. The upstream valve on the line is normally fully open and the downstream valve is normally partially open.

4.2 Maintenance of Dam. The dam is visited twice a week by a caretaker who checks the reservoir elevation. When the reservoir is below the spillway crest, the caretaker reports the reservoir elevation to the Owner's Engineering Department. This information is used by the Engineering Department for regulating flows in the distribution system. A Pennsylvania Gas and Water Company engineer makes a formal inspection of the dam each year, and the records are kept on file and are used for determining priority of repairs. Informal inspections are also made when the engineer is on the site for other reasons.

4.3 Maintenance of Operating Facilities. The screen in the masonry intake structure is cleaned in the fall when leaves tend to clog it or whenever there is indication of a pressure drop. The downstream valve is operated annually. The upstream valve is not regularly operated.

4.4 Warning System in Effect. The Owner furnished the inspection team with a chain of command diagram for Olyphant No. 2 Dam and a generalized emergency notification list that is applicable for all the Pennsylvania Gas and Water Company dams. The Owner said that during periods of heavy rainfall, available personnel are dispatched to the dams to observe conditions. All company vehicles are equipped with radios, and the personnel can communicate with each other and with a central control facility. Evaluation of risk is made by the Owner's Engineering Department. The Owner's Engineering Department is also responsible for notification of emergency conditions to the local authorities. Detailed emergency operational procedures have not been formally established for Olyphant No. 2 Dam, but are as directed by the Owner's Engineering Department.

4.5 Evaluation. The operational procedure appears to be satisfactory, except for the cutting of brush on the embankment.

The only access to the outlet works is across the bottom of the spillway apron. During periods of high spillway discharge, access to the outlet works would not be possible by this means of access. The procedures used by the Owner for inspecting the dam are adequate, but the needed repairs have not been made. In general, the warning system is adequate, but it is not in sufficient detail for Olyphant No. 2 Dam when its overall condition and importance is considered.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data.

(1) No hydrologic and hydraulic analysis for the original Olyphant No. 2 Dam design was available for review. The dam was overtopped in 1903, and the parapet wall atop the gravity masonry section was added at that time. The spillway capacity was estimated by the Pennsylvania Water Supply Commission in their 1914 report. The storm of May 1942 filled the reservoir to the approximate level of the top of dam.

(2) In the recommended guidelines for safety inspection of dams, the Department of the Army, Office of the Chief of Engineers (OCE), established criteria for rating the capacity of spillways. The recommended spillway design flood for the size (intermediate) and hazard potential (high) classification of Olyphant No. 2 Dam is the PMF. If the dam and spillway are not capable of passing the PMF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

(3) Although the spillway capacity and hydrology have been estimated a number of times by the Owner, the design storms used were far below the probable maximum flood. Most of the analyses failed to include the effects of the Olyphant No. 3 Dam, located on Grassy Island Creek about 0.4 mile upstream of Olyphant No. 2 Reservoir. The Owner's most recent estimate of spillway capacity is 1,170 cfs. Calculations were performed to check the accuracy of this figure. The spillway capacity was calculated to be 1,140 cfs and this capacity was used in this study.

(4) Olyphant No. 3 Dam (Photographs I and J) has a drainage area of 0.7 square mile. Olyphant No. 3 Dam is an earth embankment 700 feet long and 30 feet high. The embankment has a puddle core of clay and gravel. The top width is 12 feet, the upstream slope is 1V on 3H, and the downstream slope is 1V on 2H. The slopes are riprapped. A brief visit to the site was made during the course of the inspection for Olyphant No. 2 Dam. Only the spillway was inspected in detail. The drawings that are available for Olyphant No. 3 Dam show the spillway as a paved channel at the right abutment of the dam. The inspection revealed that the spillway at present more approximates a natural rocky channel. Measurements made during the inspection showed the spillway has a length of 44 feet, with a 1.2-foot head, from crest to top of dam. The spillway had a small flow discharging over it. Beavers had constructed a dam at the spillway which blocked about 50 percent of it. The Owner reported that a beaver dam had been removed the previous week. Except for the spillway information, the data concerning this dam was taken from the Owner's records.

(5) The hydrologic analysis for this study was based on existing conditions of Olyphant No. 2 watershed and the effects of future development of the watershed were not considered.

b. Visual Observations. On the date of the inspection, no conditions were observed that would indicate that the spillway capacity would be significantly reduced during a flood occurrence.

c. Experience Data. The PMF peak discharge was estimated by transposition of a PMF peak discharge derived for hydrologically similar Lake Aylesworth watershed. The PMF peak discharge for Olyphant No. 3 Dam was derived by identical methods. The PMF peak discharge for the entire Olyphant No. 2 watershed is estimated at 7,440 cfs. The Olyphant No. 3 component of the Olyphant No. 2 PMF is 1,800 cfs. The component of the Olyphant No. 2 PMF on the drainage area between Olyphant No. 2 and Olyphant No. 3 Dams is 5,640 cfs. Hydrologic computations are presented in Appendix C.

d. Overtopping Potential. One case was analyzed to check the overtopping potential of Olyphant No. 2 Dam from a PMF storm. This case considered a PMF storm only over that portion of the drainage area between Olyphant No. 2 Dam and Olyphant No. 3 Dam. This portion of the drainage area is 2.2 square miles. This analysis is equivalent to assuming that Olyphant No. 3 Dam will hold back the entire PMF runoff from its drainage area (0.7 square mile). The PMF inflow into Olyphant No. 2 Reservoir for this case would be 5,640 cfs and it is greater than the spillway capacity of Olyphant No. 2 Dam. A check of

the surcharge storage effect of Olyphant No. 2 Reservoir shows that the surcharge storage available is insufficient to contain an inflow with a peak of 5,640 cfs without overtopping the dam. It is apparent, therefore, that a PMF storm over the entire Olyphant No. 2 watershed would also cause overtopping of Olyphant No. 2 Dam regardless of any mitigating effects of Olyphant No. 3 Dam.

One case was analyzed to check the overtopping potential of Olyphant No. 3 Dam from a PMF storm. This case considered the Olyphant No. 3 component of the Olyphant No. 2 PMF. The PMF peak inflow into Olyphant No. 3 Reservoir for this case is 1,800 cfs and is greater than the spillway capacity of Olyphant No. 3 Dam. A check of the surcharge storage effect of Olyphant No. 3 Reservoir shows that the surcharge storage available is insufficient to contain an inflow with a peak of 1,800 cfs without overtopping the dam.

One case was analyzed to check the overtopping potential of Olyphant No. 3 Dam from a storm equal to one-half of the PMF. This case was based on the Olyphant No. 3 component of the Olyphant No. 2 one-half PMF. The peak inflow of 900 cfs is greater than the spillway capacity of Olyphant No. 3 Dam. A check of the surcharge storage effect of Olyphant No. 3 Reservoir shows that surcharge storage available is insufficient to contain an inflow with a peak of 900 cfs without overtopping the dam.

Two cases were analyzed to check the overtopping potential of Olyphant No. 2 Dam from a storm equal to one-half of the PMF. Case 1 was based on the Olyphant No. 2 one-half PMF over the drainage area between Olyphant No. 2 and No. 3 Dams. This case is similar to the analysis of Olyphant No. 2 Dam for the PMF. Case 2 was based on the Olyphant No. 3 component of the Olyphant No. 2 one-half PMF over the Olyphant No. 3 watershed with the overtopping and assumed failures of Olyphant No. 3 Dam. For Case 2, runoff from the drainage area between Olyphant No. 2 and Olyphant No. 3 Dams was not considered. Case 1 resulted in a one-half PMF peak inflow of 2,820 cfs which is greater than the spillway capacity of Olyphant No. 2 Dam. A check of the surcharge storage effect of Olyphant No. 2 Reservoir shows that the surcharge storage available is insufficient to contain an inflow with a peak of 2,820 cfs without overtopping. For Case 2, a failure hydrograph for Olyphant No. 3 Dam was estimated and a peak inflow as high as 75,000 cfs could rush into Olyphant No. 2 Reservoir, totally emptying Olyphant No. 3 Reservoir in 3 minutes. Results of the Case 2 analysis show that the surcharge storage available in Olyphant No. 2 Reservoir is insufficient to contain the Olyphant No. 3 failure hydrograph without overtopping Olyphant No. 2 Dam.

e. Downstream Conditions. Olyphant No. 2 Dam is 0.2 mile upstream of Olyphant No. 1 Dam, which is a very small intake dam. It would have insignificant effect on floodflows. It is sufficiently low and has such small storage that failure would not add a significant amount of water to the stream. Likewise, it would provide no mitigating effects to floods originating upstream. Downstream of Olyphant No. 1 Dam, Grassy Island Creek flows for 1.3 miles through an abandoned strip mine. This mine could have significant mitigating effect on floodflows, but insufficient information was available to assess these effects. The stream then flows 0.6 mile to the Lackawanna River past Winton, Pennsylvania, which is not sufficiently high above the stream to avoid being flooded by major floods in Grassy Island Creek. Unless the effects of the abandoned strip mine are significant, the downstream conditions indicate that a high hazard classification is warranted for Olyphant No. 2 Dam.

f. Spillway Adequacy.

(1) Considering the effects of the surcharge storage of Olyphant No. 3 Reservoir, Olyphant No. 3 Dam will not pass its component of either the Olyphant No. 2 PMF or one-half PMF without overtopping and probable failure of Olyphant No. 3 Dam. Considering the effects of surcharge storage in Olyphant No. 2 Reservoir and assuming that Olyphant No. 3 Reservoir stores all of its component of the inflow from either the Olyphant No. 2 PMF or one-half PMF, Olyphant No. 2 Dam will not pass either the PMF or one-half PMF without overtopping. Furthermore, considering the effects of the surcharge storage of Olyphant No. 2 Reservoir, Olyphant No. 2 Dam will not pass the estimated inflow from the failure of Olyphant No. 3 Dam without overtopping.

(2) The maximum tailwater is estimated to be Elevation 1279 at the spillway capacity of 1,140 cfs. At maximum pool elevation, there is a difference of about 69 feet between headwater and tailwater. If Olyphant No. 2 Dam should fail due to overtopping, the hazard to loss of life downstream from the dam will be significantly increased from that which would exist just prior to overtopping.

(3) Based on established OCE criteria as outlined in Paragraph 5.1.a.(2), the spillway capacity of Olyphant No. 2 Dam is rated as seriously inadequate. For Olyphant No. 3 Dam, considering the effects of the surcharge storage of 12 acre-feet, the Olyphant No. 3 spillway discharge capacity of 140 cfs can accommodate a flood with a peak inflow of 155 cfs for a storm of the same duration as the Olyphant No. 3 PMF. This is 6 percent of the Olyphant No. 3 PMF peak inflow. Considering the effects of the combined Olyphant No. 2 Reservoir and Olyphant No. 3 Reservoir surcharge storage of 55 acre-feet, the Olyphant No. 2

spillway discharge capacity of 1,140 cfs can accommodate a flood with a peak inflow of 1,200 cfs for a storm of the same duration as the Olyphant No. 2 PMF. This is 16 percent of the Olyphant No. 2 PMF.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspections of the dam resulted in some observations that are relevant to structural stability. These observations are listed herein for the various features.

(2) Earthfill Section of Dam. A wet area and sloughed area were observed at and near the embankment. The detailed description and evaluation of the conditions are in Paragraphs 3.1.b.(1) and 3.2.a.(1), respectively.

(3) Spillway Walls. The concrete and mortar on the spillway walls are deteriorated. The left spillway wall is tilted and bowed. The detailed description of the conditions are in Paragraphs 3.1.c.(3) and (4). The detailed evaluation of the conditions are in Paragraphs 3.2.b.(3) and (4).

b. Design and Construction Data. No records of design data or stability computations for the original structures or for either the 1903 or early 1920's modifications were available for review. However, stability studies for the spillway were performed in 1914 by the Pennsylvania Water Supply Commission, and the results of the analyses are on file.

The principal feature that can be evaluated by stability computations is the spillway. For the spillway, the 1914 analysis was reviewed to assess the stability of the section. The loading conditions used in that study were: full hydrostatic pressure on the upstream face, water level 5 feet over spillway crest, and uplift varying uniformly from two-thirds full hydrostatic pressure at the heel to zero at the toe. The results indicated that the resultant was within the middle third and that toe pressure and resistance to sliding were satisfactory.

For this study, another stability analysis was performed on the spillway which included the effects of tailwater. The loading assumptions were as follows: water at maximum pool level, full hydrostatic pressure on the upstream face and uplift varying uniformly from full tailwater at the toe to full tailwater at the heel plus 2/3 of the difference between headwater and tailwater also applied at the heel. The analysis showed that the toe pressure and sliding factor were within acceptable limits

and the resultant was within the middle third. Consequently, the spillway meets the recommended OCE guidelines for stability.

As was noted in Paragraphs 2.1.c.(1) and (2), the design of the composite masonry gravity earthfill-dam was not in accordance with the best engineering practice at the time of design. The stability of the composite section, both for maximum pool and sudden drawdown conditions, is questionable. There is insufficient information to evaluate the stability of this composite section.

c. Operating Records. There is no evidence in the available records that any stability problems have occurred for the spillway during the operational history of the dam. It is known that the sloughing of the earthfill and the wet area at the toe of the earthfill have been noted on previous inspections.

d. Post-Construction Changes. No detailed information is available for review concerning any modifications made to Olyphant No. 2 Dam.

e. Seismic Stability. Olyphant No. 2 Dam is located in Seismic Zone 1. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading. However, since there is the potential of earthquake forces moving or cracking the masonry gravity section, the theoretical seismic stability of this dam cannot be assessed.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on the visual inspection, available records, calculations and past operational performance, Olyphant No. 2 Dam is judged to be in fair condition. Deficiencies of varying degree of importance were noted. A summary of the features and observed deficiencies is listed below:

Feature and Location	Observed Deficiencies
Dam:	
Earthfill left of spillway	Steep slopes, brush, sloughing, seepage downstream of toe, mounds upon embankment.
Earthfill right of spillway	Steep slopes, brush, dry masonry wall at toe.
Masonry gravity section	Deteriorated mortar, possible failure during drawdown.
Spillway Walls and Apron:	Deteriorated concrete, bowed and tilted wall, possible seepage, deteriorated mortar, previous overtopping.
Spillway Channel:	Possible previous sloughing.
Outlet Works:	Poor access, pipe under pressure through earthfill.
Downstream Channel:	Poor access road.

(2) The overtopping potential analysis shows that for a storm occurring only over the drainage area between Olyphant No. 2 Dam and Olyphant No. 3 Dam, Olyphant No. 2 Dam will be overtopped by the PMF or one-half the PMF. Therefore, based on OCE criteria, as outlined in Paragraphs 5.1.a.(2), the spillway capacity is rated as seriously inadequate. The existing spillway can accommodate a flood with a peak inflow of 16 percent of the PMF peak inflow. Additional analyses for the overtopping potential of Olyphant No. 2 Dam included consideration

of the hydrologic and hydraulic effects of Olyphant No. 3 Dam, which is located on Grassy Island Creek about 0.3 mile upstream from Olyphant No. 2 Reservoir. Results of the analyses show that Olyphant No. 2 Dam will be overtopped by one-half the PMF (storm over Olyphant No. 3 watershed only). A failure hydrograph of Olyphant No. 3 Dam was made and it was found that if Olyphant No. 3 Dam failed, the spillway capacity and surcharge storage effect of Olyphant No. 2 Dam were insufficient to contain the Olyphant No. 3 failure hydrograph without overtopping the dam.

(3) Review of stability computations that are on file and computations performed for this study indicate that the spillway is apparently structurally adequate for the maximum pool condition. For the maximum pool condition, computations show that the resultant is within the middle third and the toe pressure and sliding factor are within acceptable limits.

b. Adequacy of Information. There is not sufficient information to assess the stability of the masonry gravity section and downstream earthfill. However, the information available is such that an assessment of the condition of other features of the dam can be inferred from the combination of visual inspection, past performance, computations performed prior to and as a part of this study, and other information.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented as soon as practical or in a timely manner, as noted.

d. Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations will be required.

7.2 Recommendations and Remedial Measures.

a. In view of the concern for safety of Olyphant No. 2 Dam, the following measures are recommended to be undertaken by the Owner as soon as practical:

(1) Develop a detailed emergency operation and warning system for the Olyphant No. 2 and Olyphant No. 3 Dam system.

(2) Perform additional studies to more accurately ascertain the spillway capacity required for Olyphant No. 2 Dam, as well as the nature and extent of mitigation measures required to make the spillway hydraulically adequate.

(3) Perform investigations and studies to more accurately ascertain structural deficiencies in the spillway apron, left spillway training wall and the sloughed area of the earthfill, as well as the nature and extent of mitigation measures required to make these features structurally adequate. The investigations and studies should also address the structural adequacy of the masonry gravity section and downstream earthfill for all operating conditions.

(4) Provide closure facilities for the outlet works upstream of the masonry gravity section.

(5) Provide a means of access across the spillway or spillway channel and adequate access to the dam.

b. In order to correct operational, maintenance, and repair deficiencies and to more accurately assess the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner:

(1) Remove brush from earthfill slopes.

(2) Provide six observation wells or other instrumentation in the earthfill slopes, three on each side of the spillway. Also, one observation well or other instrumentation should be placed in the vicinity of the wet area. Instruments should be read periodically and any rises in water level should be analyzed to determine the effect on the stability of the earth slopes and earth-masonry dam. Monitor wet and seepage areas and if conditions worsen take necessary action.

(3) Place fill under the end of the left spillway training wall and provide erosion protection.

(4) Raise the downstream end of the right spillway training wall to prevent overtopping.

(5) Repair deteriorating concrete on the spillway training walls.

(6) Repair or replace mortar in the spillway training walls and masonry gravity section.

(7) Repair leaking valve.

c. Until remedial work that corrects hydraulic deficiencies of the spillway is complete, the following measures are recommended to be undertaken by the Owner:

(1) Provide round-the-clock surveillance of Olyphant No. 2 and Olyphant No. 3 Dams during periods of unusually heavy rains.

(2) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

SUSQUEHANNA RIVER BASIN

GRASSY ISLAND CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

OLYPHANT NO. 2 DAM

NDS ID No. 382

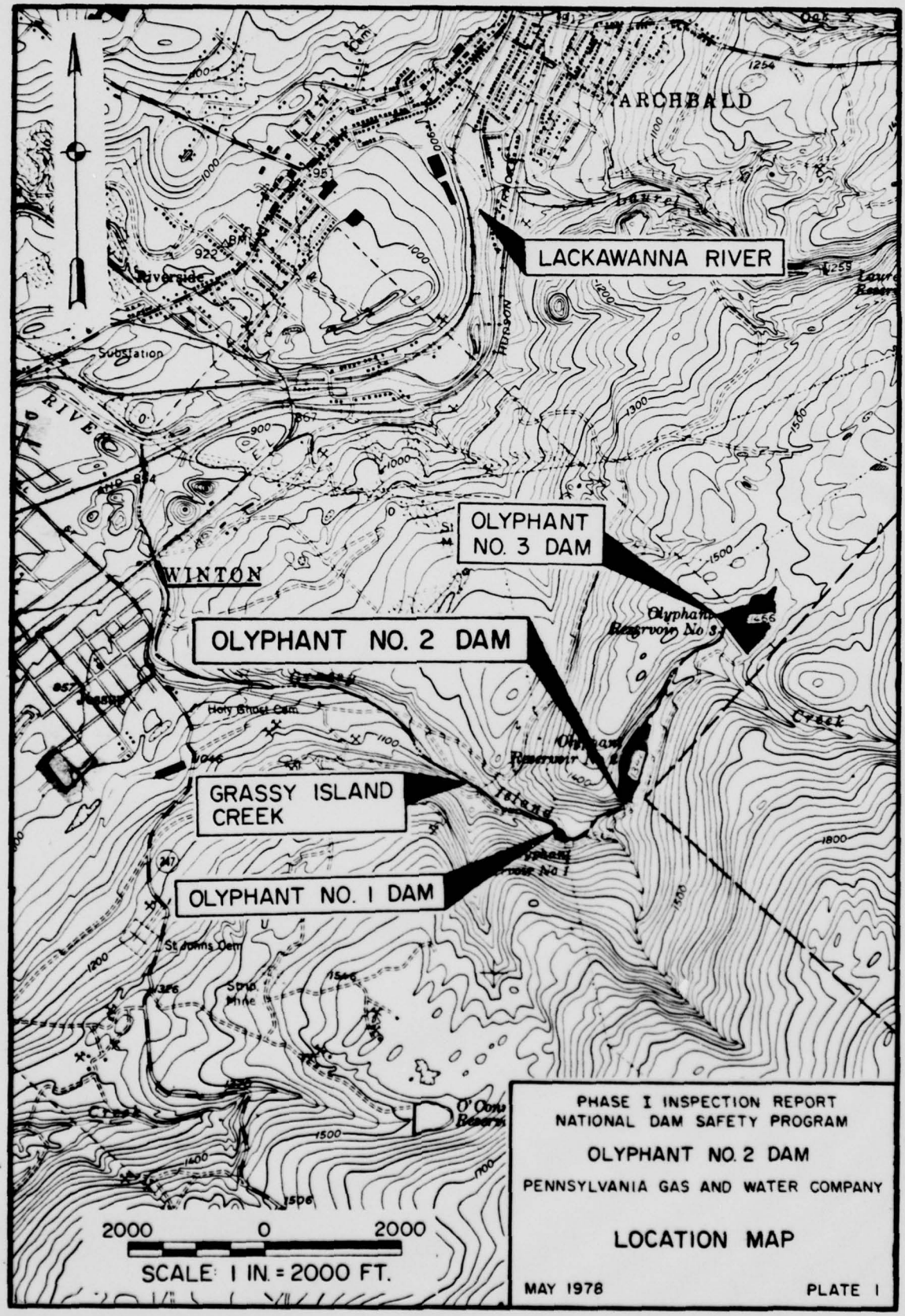
PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

MAY 1978

PLATES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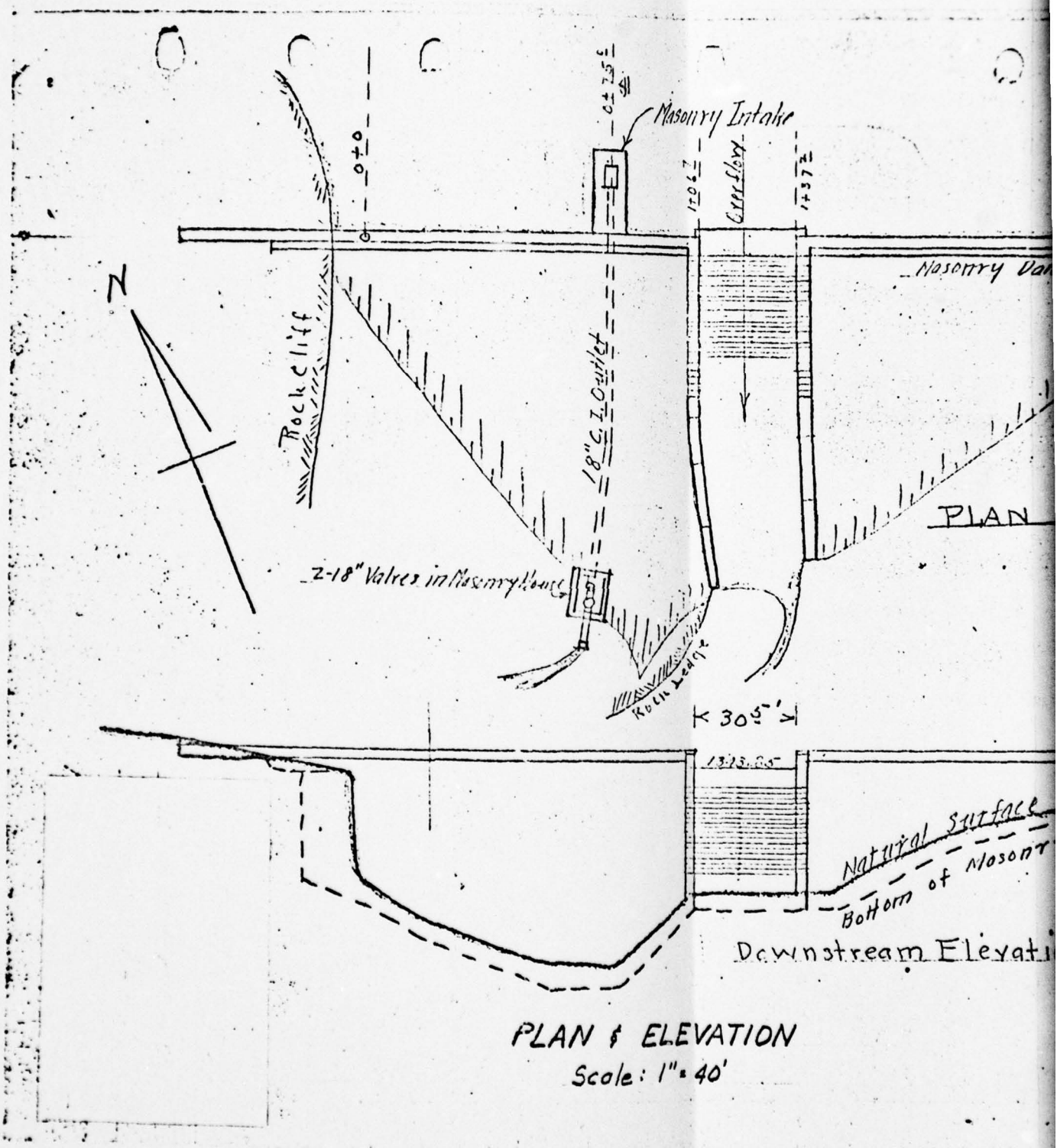
LACKAWANNA RIVER
OLYPHANT NO. 3 DAM
OLYPHANT NO. 2 DAM
GRASSY ISLAND CREEK
OLYPHANT NO. 1 DAM
WINTON
Riverside
Substation
Holy Ghost Cem.
St. Johns Cem.
Spoil Pile
Island
Creek
2000 0 2000
SCALE: 1 IN. = 2000 FT.
PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
OLYPHANT NO. 2 DAM
PENNSYLVANIA GAS AND WATER COMPANY
LOCATION MAP
MAY 1978
PLATE 1



PLAN & ELEVATION
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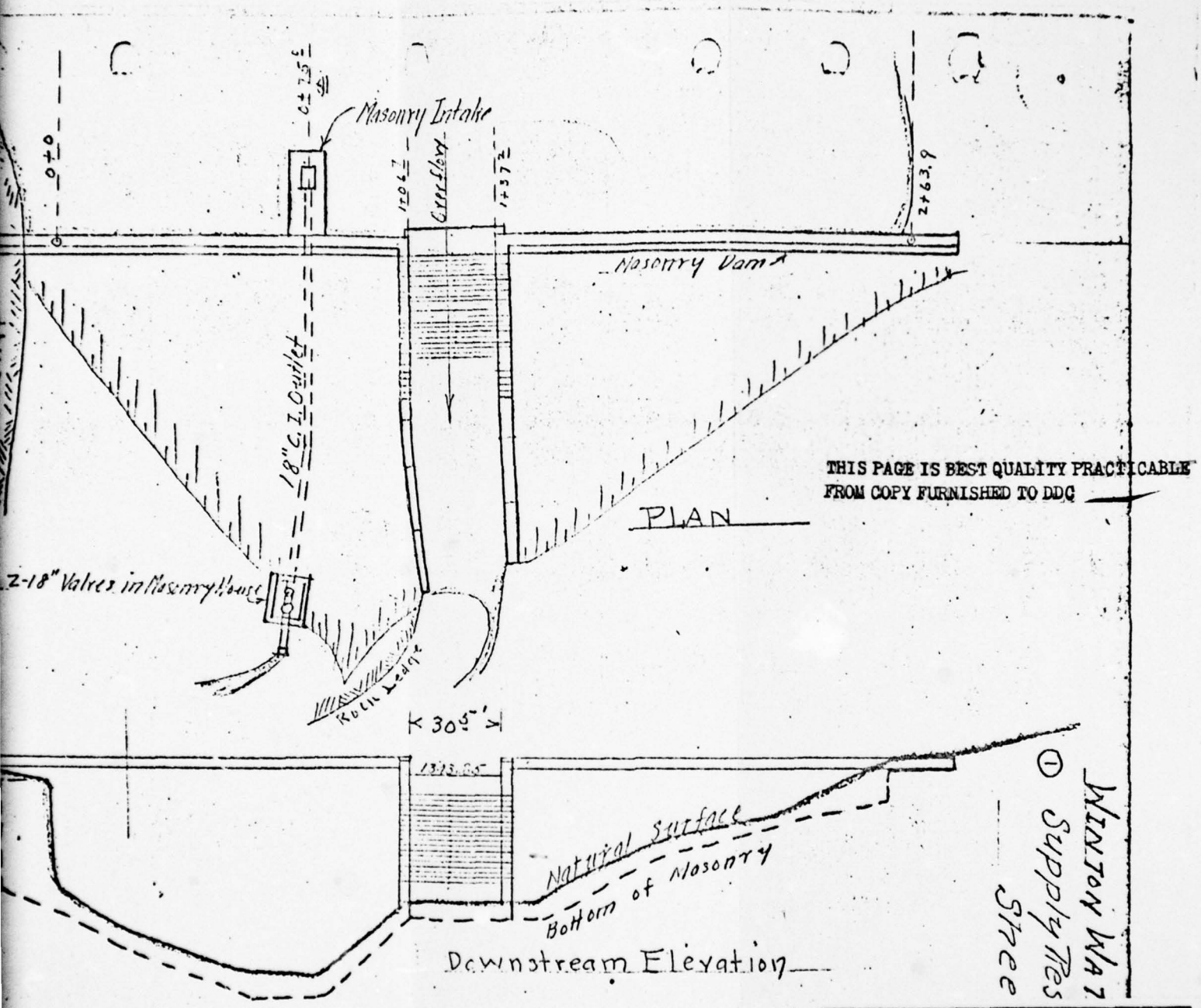
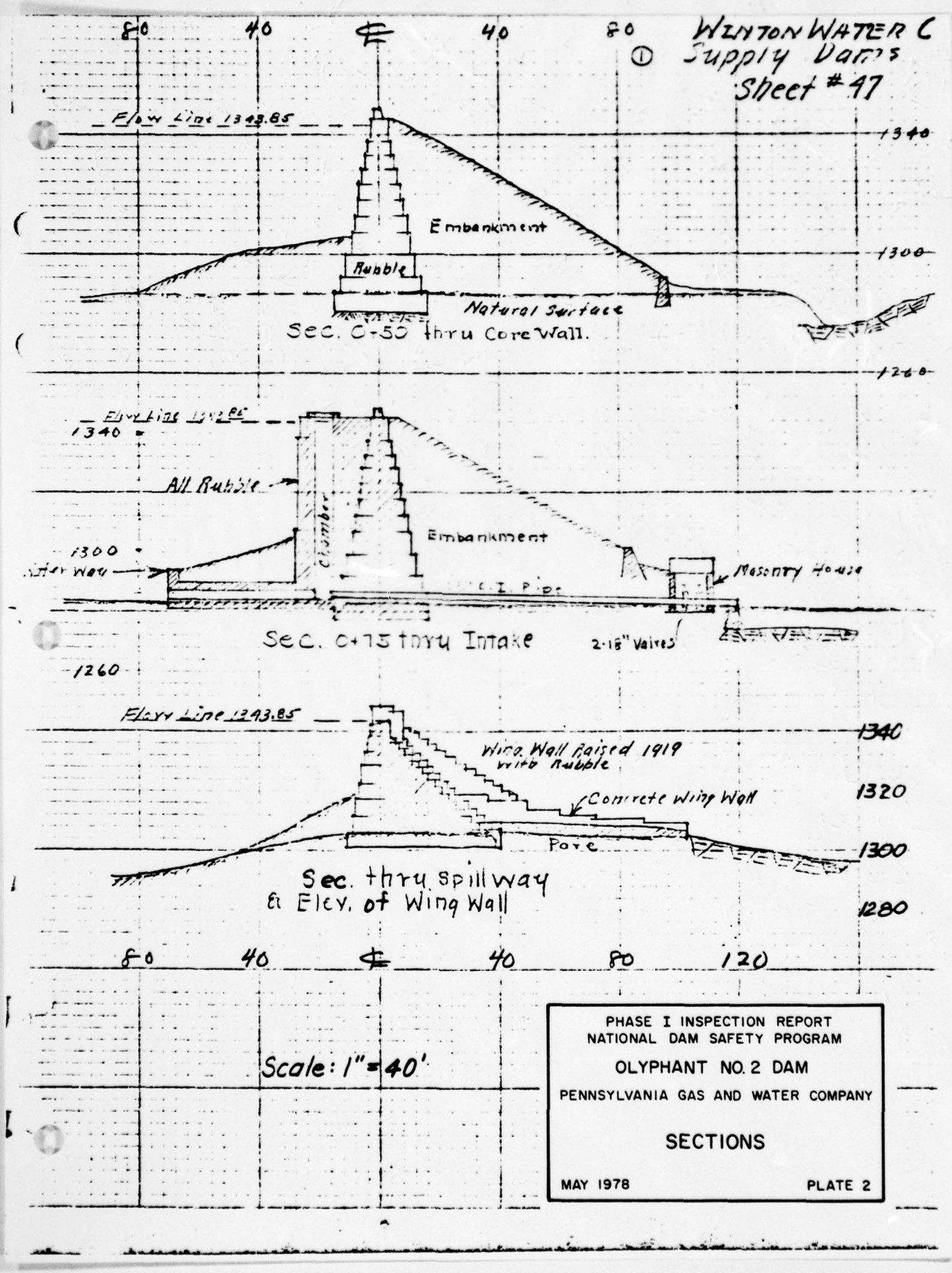


PLAN & ELEVATION
Scale: 1" = 40'

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
OLYPHANT NO. 2 DAM
PENNSYLVANIA GAS AND WATER COMPANY
PLAN AND PROFILE
MAY 1978 PLATE 1A



WILLTON WATER CO
① Supply Dams
Sheet #47

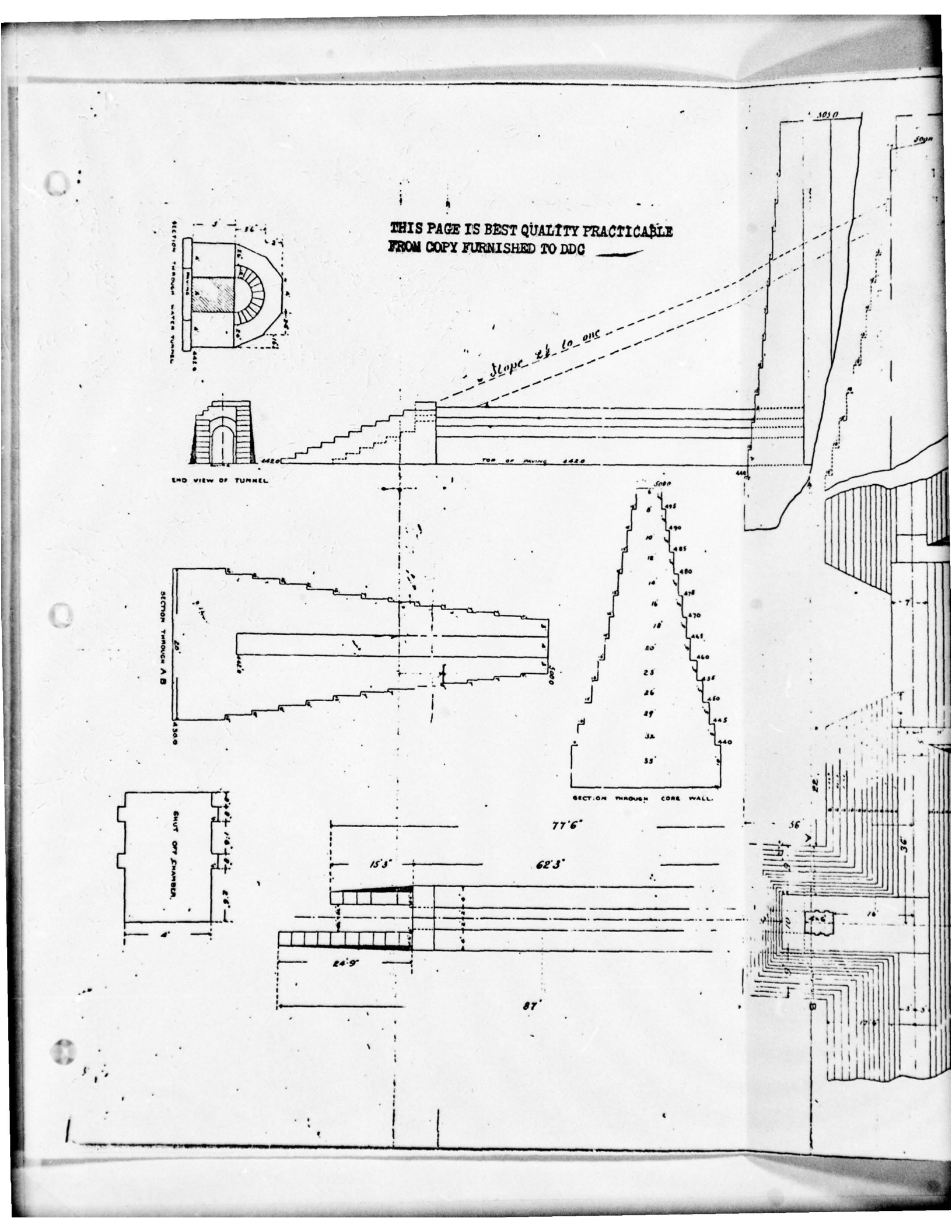
PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

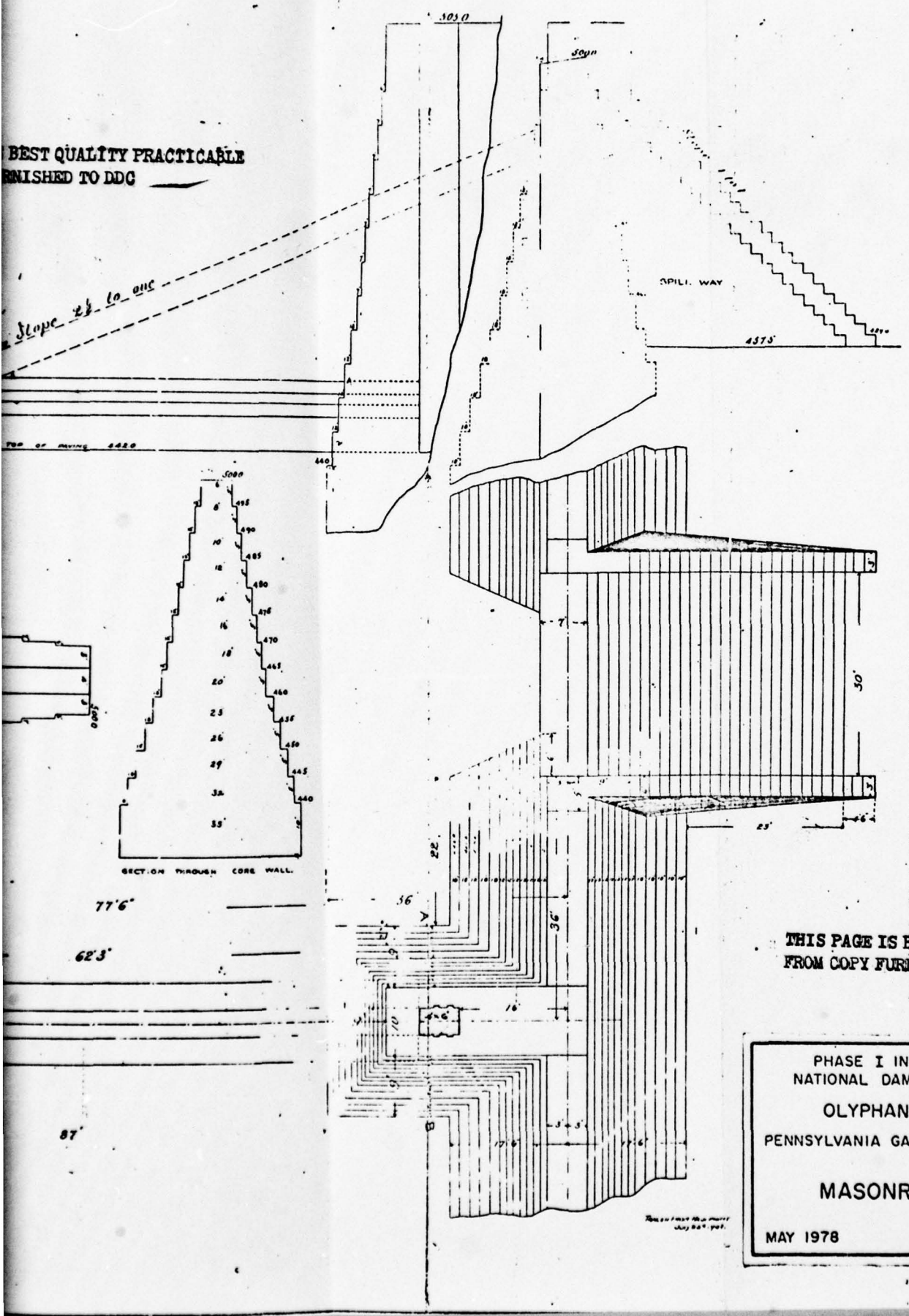
OLYPHANT NO. 2 DAM

PENNSYLVANIA GAS AND WATER COMPANY

SECTIONS

MAY 1978 PLATE 2





PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

OLYPHANT NO. 2 DAM

PENNSYLVANIA GAS AND WATER COMPANY

MASONRY DETAILS

MAY 1978 PLATE 3

SUSQUEHANNA RIVER BASIN

GRASSY ISLAND CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

OLYPHANT NO. 2 DAM

NDS ID No. 382

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

MAY 1978

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: Olyphant No. 2

NDS ID NO.: 382 DER ID NO.: 35-4

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	None. Relatively detailed masonry plans available, but elevations use arbitrary datum.
REGIONAL VICINITY MAP	Project is shown on USGS Quadrangle - Olyphant, Pennsylvania, N 4122.5 - W 7530/7.5, 1946, photo revised in 1969.
CONSTRUCTION HISTORY	Built for Winton Water Company, 1888. Parapet wall added in 1903. Spillway walls raised in early 1920's.
TYPICAL SECTIONS OF DAM	General sections available from Owner; they do not entirely agree with field conditions.
OUTLETS: Plan Details Constraints Discharge Ratings	Generalized plan available. No details or ratings available.

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	None.
DESIGN REPORTS	None.
GEOLOGY REPORTS	1914: Water Supply Commission of Pennsylvania has general geologic description.
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	1914: Hydraulic and stability analysis of dam and spillway.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	None.
POSTCONSTRUCTION SURVEYS OF DAM	None.

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	1914 Report notes masonry borrowed from onsite or from immediate vicinity.
MONITORING SYSTEMS	None.
MODIFICATIONS	1903: Parapet wall added. Early 1920's (between 1919 and 1925): Spillway walls raised.
HIGH POOL RECORDS	Owner reports flood of record was May 1942; 5 feet of water over crest.
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	1914 Report by Water Supply Commission of Pennsylvania recommended raising spillway walls.
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	1903: Overtopped; erosion of downstream embankment.

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	No detailed records.
SPILLWAY: Plan Sections Details	Plan and section of masonry available. No detailed overall plan or details available.
OPERATING EQUIPMENT: Plans Details	Generalized plan available. No details available.
PREVIOUS INSPECTIONS Dates Deficiencies (Cont'd. on Page A-5)	1919: Spillway walls too low. 1925: Pointing required at foot of spillway. 1928: Wet area at foot of left hill and toe. Embankment at right of spillway appeared lower than remainder. 1930: Small amount of leakage at center of spillway just below toe. 1933: Seepage and swampy area at left end of toe. Small amount of riprap washed away from downstream end of spillway. 1934: Small amount of seepage through spillway masonry joints. 1941: Downstream face of spillway: joints need repointing. Slight seepage at toe and toe at left end. 1945: Brush on embankment. 15 linear feet of embankment washed out by splashing over left abutment spillway wall. Seepage noted through left abutment. Swampy condition at lower toe at left end.

ENGINEERING DATA

ITEM	REMARKS
PREVIOUS INSPECTIONS: (Cont'd.)	1953: Slight leakage along toe at left end abutment. 1957: Spillway channel split and broken. 1965: Trees and brush on downstream face.

CHECKLIST

ENGINEERING DATA

HYDROLOGY AND HYDRAULICS

NAME OF DAM: Olyphant No. 2 NDS ID NO.: 382 DER ID NO.: 35-4

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1343.85

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1349.0

ELEVATION MAXIMUM DESIGN POOL: 1349.0

ELEVATION TOP DAM: 1349.0

SPILLWAY CREST:
- a. Elevation 1343.85
- b. Type Broad Crested Weir with Masonry Steps
- c. Width 7.0 feet
- d. Length 30.5 feet
- e. Location Spillover Middle of Dam
- f. Number and Type of Gates None

OUTLET WORKS:
- a. Type 18-Inch CIP and Masonry Tunnel
- b. Location Right of Spillway
- c. Entrance Inverts 1285.9±
- d. Exit Inverts 1280.0±
- e. Emergency Draindown Facilities (Above)

HYDROMETEOROLOGICAL GAGES:
- a. Type None
- b. Location None
- c. Records None

MAXIMUM NONDAMAGING DISCHARGE: 1,140 cfs

SUSQUEHANNA RIVER BASIN

GRASSY ISLAND CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

OLYPHANT NO. 2 DAM

NDS ID No. 382

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

MAY 1978

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: Olyphant No. 2 County: Lackawanna State: Pennsylvania

NDS ID No.: 382 DER ID No.: 35-4

Type of Dam: Masonry and Earth Hazard Category: High

Date(s) Inspection: April 26 and 27, 1978 Weather: April 26: Clear & Windy / April 27: Thin Clouds & Windy Temperature: 60°F.

Soil - moist. Some standing water in access roads.

Pool Elevation at Time of Inspection: 1344.0 msl/Tailwater at Time of Inspection: 1298.0 msl

Inspection Personnel:

F. Mansour (GFCC)	J. Skoritowski (PG & W)	
P. van der Goes (GFCC)	D. Kauffman (PG & W)	
D. Ebersole (GFCC)	S. Perko (PG & W)	

A. Whitman (GFCC) Recorder

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	At flat spot of left embankment: two lumps 6.5' wide x 10' long x 1' high.	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	Upper left embankment by junction spillway wall - sloughing - area 6' x 6' - soil slightly damper than adjacent.	Soil not saturated.
CREST ALIGNMENT: Vertical Horizontal	Horizontal: straight. Vertical: surveyed.	
RIPRAP FAILURES	No riprap.	

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	Behind left spillway wall soil has settled 6 inches. (See "spillway")	
ANY NOTICEABLE SEEPAGE	110 feet downstream of spillway, 30 feet left, wet area 16' wide x 50' long. Downstream of left spillway wall - clear seepage of 0.25 gpm.	20 feet downstream of left spillway wall offset 12 feet left.
STAFF GAGE AND RECORDER	None.	
DRAINS	None.	

CONCRETE/MASONRY DAMS

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Slight seepage at approximate pool level at junction left wall masonry gravity structure and left spillway wall.	
JUNCTION OF STRUCTURE WITH: Abutment Embankment Other Features	No visible defects except at junction with spillway. (See "spillway")	
DRAINS	None.	
WATER PASSAGES	No observable defects.	
FOUNDATION	No observable defects.	

CONCRETE/MASONRY DAMS

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SURFACES: Surface Cracks Spalling	None.	
STRUCTURAL CRACKING	None.	
ALIGNMENT: Vertical Horizontal	Horizontal: straight. Vertical: surveyed.	
MONOLITH JOINTS	Mortar very deteriorated, especially in parapet wall joints. Rule can be inserted up to 4 inches in some joints.	
CONSTRUCTION JOINTS	None	
STAFF GAGE OR RECORDER	None.	

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None.	Small crack (wedge missing) in exposed end of 18-inch pipe.
INTAKE STRUCTURE	Not observable.	
OUTLET STRUCTURE	Valve House: slight leak in valve; water ran over valve casing.	
OUTLET CHANNEL	No defects.	
EMERGENCY GATE	None.	

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Water flowing over weir; no observable defects.	
APPROACH CHANNEL	Reservoir.	
DISCHARGE CHANNEL	See last sheet.	
BRIDGE AND PIERS	None.	

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Earth - 1V on 4H; much outcrop visible.	
SEDIMENTATION	No observable defects. Owner reports no problems.	
WATERSHED DESCRIPTION	Wooded with hardwoods; most of watershed is posted by Owner.	

DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	Few small branches.	
SLOPES	Steep with outcrop.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	None observed.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
UNGATED SPILLWAY: OUTLET CHANNEL APRON	Bulged and broken all over. Material below concrete: coarse gravel and exposed. End eroded; rubble exposed.	Possible seepage near left spillway wall. Water was higher than tailwater near junction.
RIGHT WALL:	Mortar deteriorated, especially on last monolith. Spalling on concrete monolith near junction with masonry (5 feet long).	3 most downstream concrete monoliths. Horizontal crack 1/16" wide near top along each monolith. Leaching on concrete near U/S masonry.
LEFT WALL:	Bowed; center is bowed 12" toward spillway. Batter is 16V on .2H toward spillway channel. End of left wall undermined 6 inches.	Concrete monoliths: most upstream 20% spalled on water side. Middle on has spalling over 50% of top.
DOWNSTREAM SPILLWAY CHANNEL:	Few branches in stream. Left bank appears to have possibly slipped previously; it is slightly concave.	Left bank has relatively mature trees. End of right spillway wall appears to have been overtopped; bent trees, gravel and washed-out areas visible. Footing beginning to be exposed.

SUSQUEHANNA RIVER BASIN

GRASSY ISLAND CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

OLYPHANT NO. 2 DAM

NDS ID No. 382

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

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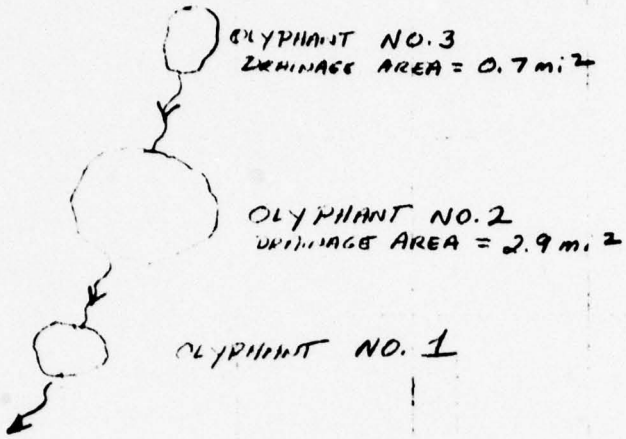
MAY 1978

APPENDIX C

HYDROLOGY AND HYDRAULICS

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT HYDRAULICS AND HYDROLOGY FILE NO.
SHEET NO. 1 OF 6 SHEETS
FOR OLYPHANT NO. 2
COMPUTED BY AJW DATE 5-19-78 CHECKED BY EFM DATE 5-24-78



NHB INSTRUCTIONS: USE LAKE ARLESWORTH PMF

$$\frac{Q_{\text{OLYPHANT NO. 2}}}{13,700} = \left(\frac{2.9}{6.22}\right)^{0.8} = 0.543$$

$Q_{\text{PEAK PMF OLYPHANT NO. 2}}$ = 7440 CFS PMF AT OLYPHANT NO. 2

$$\frac{Q_{\text{OLYPHANT NO. 3}}}{Q_{\text{LAKE ARLESWORTH}}} = \frac{Q_{\text{OLYPHANT NO. 3}}}{13,700} = \left(\frac{.7}{6.22}\right)^{0.8} = 2387 \text{ CFS}$$

USE 2390 CFS OLYPHANT NO 3 PMF

TIME OF HYDROGRAPH FROM NAB CURVE FOR SUSQUEHANNA

	DRAINAGE AREA (mi²)	TIME OF PMF HYDROGRAPH	PEAK PMF INFLOW
OLYPHANT NO. 2	2.9	22.5 HRS	7440
OLYPHANT NO. 3	0.7	20 HRS*	2390

*FOR 1 mi² LOWEST VALUE ON CURVE DERIVED ABOVE

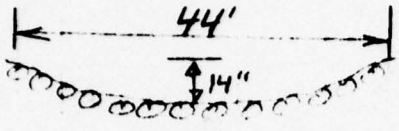
RS19

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

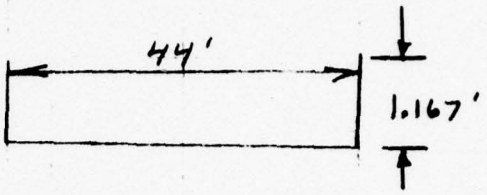
SUBJECT Hydraulics and Hydrology FILE NO.
SHEET NO. 2 OF 6 SHEETS
FOR Olyphant No. 2
COMPUTED BY CMA DATE 5/19/78 CHECKED BY FFM DATE 5-24-78

Spillway Capacity

Olyphant No. 3



Actual.



C = 2.5

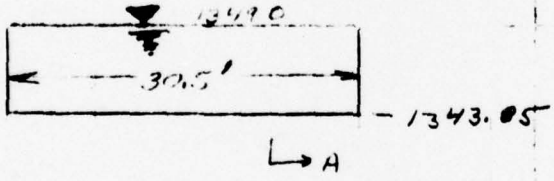
Assumed

$Q = 2.5 \times 44 \times (1.167)^{1.5} = 138.6$ cfs

Use 140 cfs

Olyphant No. 3

Olyphant No. 2



Use C = 3.2

$Q = 3.2 \times 30.5 \times (5.15)^{1.5} = 1141$ cfs

Use 1140 cfs

Olyphant No. 2

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT HYDRAULICS AND HYDROLOGY FILE NO.
SHEET NO. 3 OF 6 SHEETS
FOR OLYPHANT NO. 2
COMPUTED BY RHM DATE 5/19/78 CHECKED BY FEM DATE 5-24-78

DETERMINE COMPONENT OF OLYPHANT NO. 2 PMF WHICH FLOWS INTO OLYPHANT NO. 3

$$\frac{Q_{NO.3}}{Q_{NO.2}} = \frac{DA_{NO.3}}{DA_{NO.2}} = \frac{.7}{2.9} = .241$$

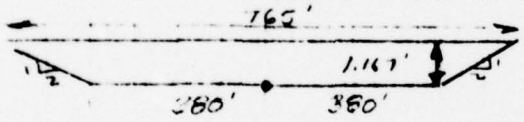
$Q_{NO.3} = 7440 \times .241 = \underline{1796 \text{ CFS}}$ USE $\underline{1800 \text{ CFS}}$

ROUTE THROUGH NO. 3 DAM

NORMAL POOL AREA = 10.4 ACRES = 453,024 FT²

EQUIVALENT RADIUS = $\sqrt{4 \times \text{AREA}}/2 \approx 380'$

ASSUME 1V ON 2H SLOPES



$A = \frac{\pi \times 765^2}{4} = 459,635 \text{ FT}^2$

$= 10.55 \text{ ACRES}$

SURCHARGE STORAGE = $1.167 \times \frac{(10.55 + 10.4)}{2} = 12.22 \text{ ACRE-FT}$

ROUTING

	PMF	½ PMF
Q PEAK PMF (CFS)	1796	898
TIME (HRS)	20	20
$P = Q_{SPILLWAY}/Q_{PEAK}$	.07795	.1559
1-P	.922	.844
STORAGE REQ'D (CFS-HRS)	16560	7579
$= (1-P)\frac{Q_{PEAK} \times TIME}{2}$ (ACRE-FT)	1369	626
STORAGE AVAILABLE (ACRE-FT)	12	12
STORAGE (REQ'D - AVAILABLE) (ACRE-FT)	1357	614

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT HYDRAULICS AND HYDROLOGY FILE NO.
SHEET NO. 4 OF 6 SHEETS
FOR OLYPHANT NO. 2
COMPUTED BY GWW DATE 5/19/78 CHECKED BY EFM DATE 5-24-78

∴ OLYPHANT NO. 3 DAM FAILS FOR PMF ON OLYPHANT NO. 2 WATERSHED.

STORAGE OF OLYPHANT NO. 3 AT NORMAL POOL
39.6 MILLION GALLONS
$= 5.29 \times 10^6$ FT^3
= 121.54 ACRE-FT.

+SURCHARGE = 12.22 ACRE-FT.

TOTAL 133.76 ACRE-FT. = 1618.5 CFS-HRS = VOLUME

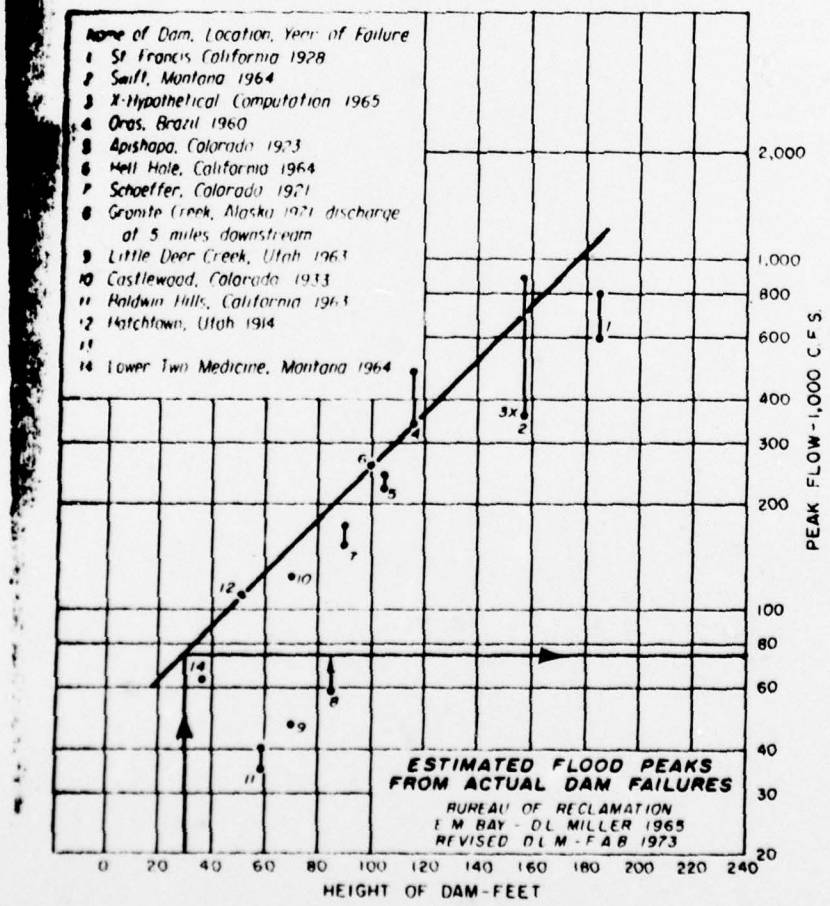


FIG. 1. -- ESTIMATED FLOOD PEAKS FROM ACTUAL DAM FAILURES

$Q_{PEAK\ OUTFLOW\ AT\ FAILURE} = 75{,}000$ CFS

$VOLUME = \frac{Q_P \times T}{2}$

$\frac{2 \times VOLUME}{Q_P} = T$

$\frac{2 \times 1618.5}{75{,}000} = T$

$= .04316$ HRS

CASES

1 - PMF ON OLYPHANT NO. 2 WITH OLYPHANT NO. 3 STORING ALL WATER

$Q_{PEAK} = 7440 \left(\frac{2.9 - .7}{2.9}\right) = 5644$ CFS

USE 5640 CFS

2 - PMF ON OLYPHANT NO. 2 IGNORING EFFECTS OF OLYPHANT NO. 3 EXCEPT ASSUMING SURCHARGE STORAGE AVAILABLE IS SUM OF SURCHARGE STORAGE FOR OLYPHANT NO's 2 & 3 COMBINED.

3 - FAILURE OF OLYPHANT NO. 3 WITH NO OTHER INFLOW TO OLYPHANT NO. 2

SURCHARGE STORAGE AVAILABLE

OLYPHANT DAMS			(ACRE-FT.)
NO. 2	NO. 3	TOTAL	
43	12	55	

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT: HYDRAULICS AND HYDROLOGY FILE NO.
FOR: CLAY PLANT NO. 2 SHEET NO. 6 OF 62 SHEETS
COMPUTED BY: ALW DATE: 5-14-76 CHECKED BY: DAM DATE: 5-14-76

FLOOD ROUTING THROUGH CLYPHANT NO. 2

	CASE 1		CASE 2		CASE 3
	PMF	½ PMF	PMF	½ PMF	FAILURE UPSTREAM
PEAK INFLOW (CFS)	5640	2820	7440	3720	75,000
TIME (HRS)	22.5	22.5	22.5	22.5	.04316
$P = \frac{Q_{SPILLWAY}}{Q_{PEAK}} = \frac{1000\ CFS}{Q_{PEAK}}$	.202	.404	.152	.306	.013
$(1-P)$	.798	.596	.847	.694	.98
REQ'D STORAGE (CFS-HRS) $= (1-P)\frac{Q_P \times T_{INF}}{2}$ (ACRE-FT)	50,632 4185	18,908 1563	70,894 5859	29,044 2,400	1511.45 124
AVAILABLE STORAGE (ACRE-FT)	43	43	55	55	43
STORAGE (REQ'D - AVAILABLE) (ACRE-FT	4142	1520	5804	2345	81

ALL CASES SHOW OVERTOPPING

DETERMINE CAPACITY OF SPILLWAY INCLUDING SURCHARGE STORAGE

$$S = (1-P)\frac{Q_P \times T}{2} \Rightarrow \frac{2S}{T} = Q_P - Q_{SPILLWAY}$$

$$Q_P = \frac{2S}{T} + Q_{SPILLWAY} = \frac{2 \times 55 \times 43560}{22.5 \times 60^2} + 1140 = 1199$$

$\approx$ 1200 CFS

$$\frac{1200}{7440} = 16.1\% \approx 16\% \text{ OF PMF}$$

CLYPHANT NO. 3 $\frac{2 \times 12 \times 43560}{20 \times 60^2} + 140 \approx 155$ CFS $\frac{155}{2390} = 6.48\% \approx 6\%$

C-6

SUSQUEHANNA RIVER BASIN

GRASSY ISLAND CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

OLYPHANT NO. 2 DAM

NDS ID No. 382

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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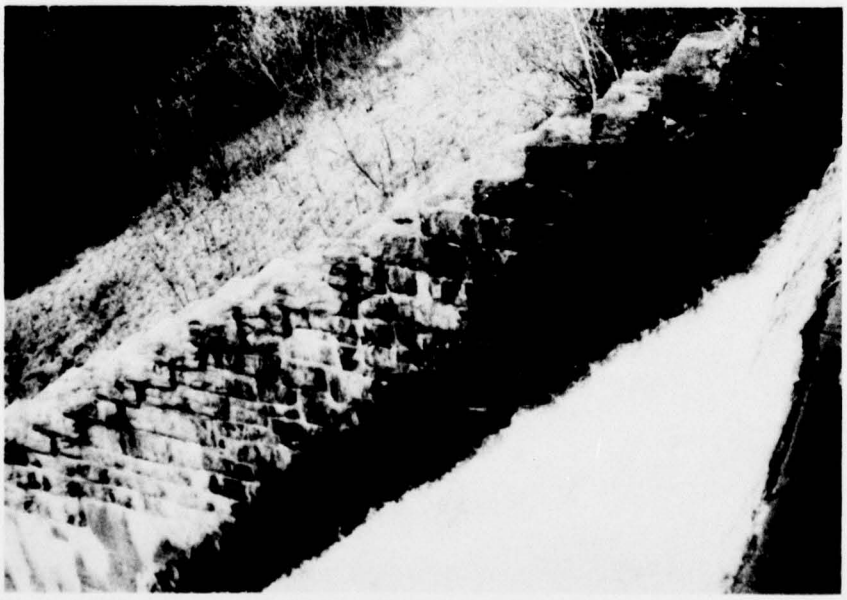
APPENDIX D

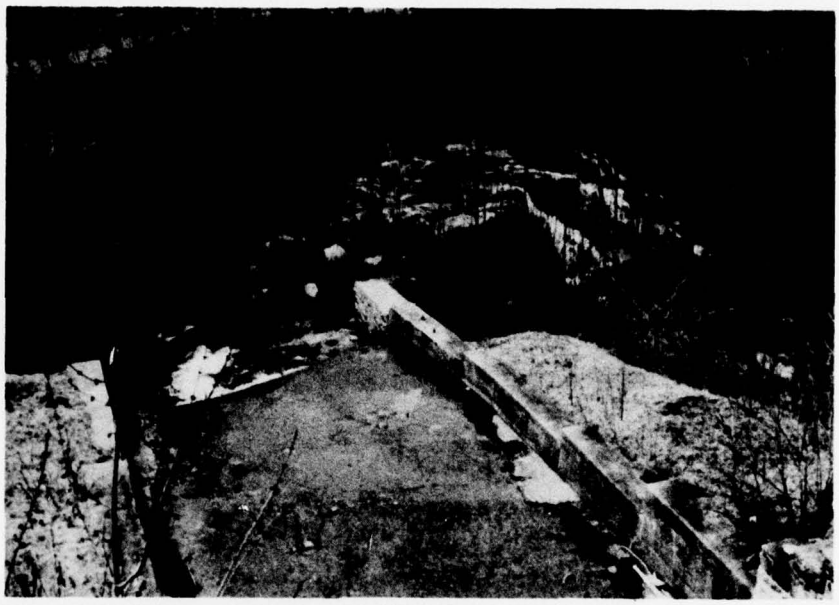
PHOTOGRAPHS

OLYPHANT NO. 2 DAM

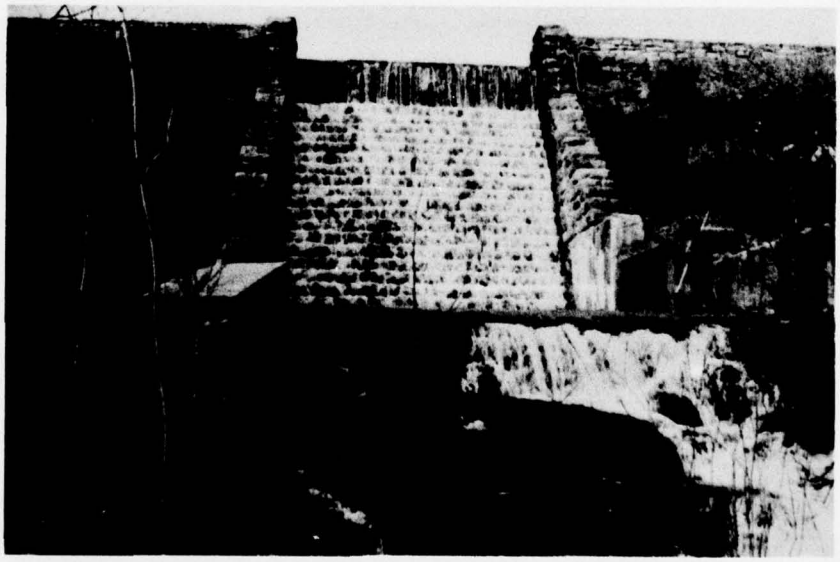
A. View from Right Abutment



B. Right Spillway Wall



C. Spillway Apron and Downstream Channel



D. Spillway and Spillway Apron

E. Left Spillway Wall

F. Wet Area at Left of Spillway Apron

G. Bow in Left Spillway Wall

H. Sloughing on Embankment
Left of Spillway — Near Crest

I. Olyphant No. 3 Dam
Located Upstream of Olyphant No. 2 Dam
View from Left Abutment

J. Olyphant No. 3 Dam
Located Upstream of Olyphant No. 2 Dam
Spillway with Beaver Dam at Left
Looking Upstream

SUSQUEHANNA RIVER BASIN

GRASSY ISLAND CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

OLYPHANT NO. 2 DAM

NDS ID No. 382

PENNSYLVANIA GAS AND WATER COMPANY

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APPENDIX E

GEOLOGY

OLYPHANT NO. 2 DAM

APPENDIX E

GEOLOGY

1. General Geology. The damsite and reservoir are located in Lackawanna County. Lackawanna County was completely covered with ice during the last continental glaciation of Pleistocene time. The general direction of ice movement was S 35°-40° W. Glacial drift covers the entire County, except where subsequent erosion has removed it. Thick deposits of glacial outwash occur in many places along the Lackawanna River, and are 50 to 100 feet thick near Dickson, Scranton, and Moosic.

The only important structural feature in Lackawanna County is the Lackawanna Syncline, which traverses the County in a southwesterly direction. The syncline enters the County at the northeast corner as a narrow shallow trough, gradually deepens and broadens toward the southweat, and reaches its maximum development in Luzerne County. The rock formations exposed range from the post-Pottsville formations (youngest) through the Pottsville, Mauch Chunk shale, Pocono sandstone to the Damascus formation of the Catskill group (oldest). The rim rocks, the Pottsville formation and Pocono sandstone, have dips that rarely exceed 10° to 20° and form a rather simple syncline. The core rocks, the post-Pottsville formations, are folded into a series of minor anticlines and synclines which trend about N 70° E. The rocks in the northwestern and southeastern parts of the County, outside of the limits of the Lackawanna Syncline, are generally horizontally stratified.

The Lackawanna River, in general, follows the axis of the Lackawanna Syncline. Southeast of the Lackawanna River, the rise in terrain is quite gradual and the crests of the high mountains are several miles from the Lackawanna River. Streams, such as Roaring Brook, Stafford Meadow Brook, and Spring Brook, have cut deep canyons through the mountains and follow a tortuous course to their confluence with the Lackawanna River near Scranton, Pennsylvania. Northwest of Lackawanna River, the mountains rise abruptly to a sharp ridge which in most places is somewhat higher than the country to the northwest. Consequently, most of the drainage in this part of the County flows westward by way of Tunkhannock Creek. A few small tributary streams, however, such as Leggetts Creek, flow eastward from this area into Lackawanna River. In the area of interest, the Lackawanna River streambed is founded in post-Pottsville formations. Proceeding uphill from the river, the older Pottsville formation, Mauch

Chunk shale, Pocono sandstone, and Catskill continental group are encountered in turn. The tributary streams, in flowing down the mountains, have generally cut through or around the hard sandstone and conglomerate members, and have eroded their streambed into the softer shales and glacial till. The Catskill continental group of rocks underlies the greater part of Lackawanna County.

2. Site Geology. Except for the geologic formations involved, the foundation conditions for Olyphant No. 2 Dam afforded by Grassy Island Creek are characteristic of numerous other streams in this section of the State. The stream has cut through an outcrop of resistant horizontally stratified Pottsville sandstone and shale and at the damsite is flowing parallel to the interface of the Pottsville and Mauch Chunk formations. The right bank of the valley consists of an almost vertical sandstone face that is very much weathered and stratified. The horizontal layers are separated by clay seams, some of which are of considerable thickness. The sandstone formation continues across the valley for about 200 feet before dropping off abruptly in the area of the original streambed. The remainder of the valley bed and the opposite, or left, bank were described in early reports as being a compact yellow clay and sand with a thick overburden of loam and boulders. The spillway and masonry section of the right half of the dam is founded on sandstone; while the left half of the dam is founded on the hardpan, which is probably either decomposed Mauch Chunk shale and/or glacial till.